Fish & Wildlife Division

RESOURCE DATA AND
SPECIES AT RISK SECTION

MULTISAR: The Milk River Basin Project

Habitat Suitability Models for Selected Wildlife Management Species

Alberta Species at Risk Report No. 86

Alberta
SUSTAINABLE RESOURCE
DEVELOPMENT

Alberta Conservation
Association
Conservation Through Collaboration

MULTISAR: The Milk River Basin Project

Habitat Suitability Models for Selected Wildlife Management Species

**Brad A. Downey, Brandy L. Downey, Richard W. Quinlan,
Oriano Castelli, Vernon J. Remesz and Paul F. Jones**

Alberta Species at Risk Report No. 86

March 2004

Alberta
SUSTAINABLE RESOURCE
DEVELOPMENT
Fish & Wildlife

Alberta Conservation
Association
Conservation Through Collaboration

104-04381/

Publication No. I/146
ISBN: 0-7785-2981-9 (Printed Edition)
ISBN: 0-7785-2982-7 (On-line Edition)
ISSN: 1496-7219 (Printed Edition)
ISSN: 1496-7146 (On-line Edition)

Illustrations by: Brian Huffman

For copies of this report, contact:

Information Centre- Publications
Alberta Environment/ Alberta Sustainable Resource Development
Main Floor, Great West Life Building
9920- 108 Street
Edmonton, Alberta, Canada T5K 2M4
Telephone: (780) 422-2079

OR

Visit our web site at:
http://ww3.gov.ab.ca/srd/fw/riskspecies/

Suggested citation formats:

Entire report

Downey B. A., B. L. Downey, R. W. Quinlan, O. Castelli, V. J. Remesz and P. F. Jones (eds.). 2004. MULTISAR: The Milk River Basin Habitat Suitability Models for Selected Wildlife Management Species. Alberta Sustainable Resource Management, Fish and Wildlife Division, Alberta Species at Risk Report No. 86, Edmonton, AB. 135 pp.

Chapter of report

Downey, B.A. 2004. Loggerhead shrike *(Lanius ludovicianus excubitorides)* pg 28-35 *in* Downey B. A., B. L. Downey, R. W. Quinlan, O. Castelli, V. J. Remesz and P. F. Jones (eds.). 2004. MULTISAR: The Milk River Basin Habitat Suitability Models for Selected Wildlife Management Species. Alberta Sustainable Resource Management, Fish and Wildlife Division, Alberta Species at Risk Report No. 86, Edmonton, AB.

TABLE OF CONTENTS

Acknowledgements...v

Introduction 1

Habitat Suitability Index Model Background...2
Paul F. Jones

Species Selection Process...8
Richard W. Quinlan

Habitat Suitability Index Models:

Birds

Burrowing Owl ***(Athene cunicularia)*** 13
Corey L. Skiftun

Ferruginous Hawk ***(Buteo regalis)*** 20
Brad N. Taylor

Loggerhead Shrike (***Lanius ludovicianus excubitorides)***.................................28
Brad A. Downey

Long-billed Curlew ***(Numenius americanus)***... 36
Brandy L. Downey

Prairie Falcon ***(Falco mexicanus)*** 42
Brad A. Downey

Sharp-tailed Grouse ***(Tympanuchus phasianellus)*** 47
Paul F. Jones

Sprague's Pipit ***(Anthus spragueii)*** 55
Julie P. Landry.

Mammals

American Badger ***(Taxidea taxus)*** 64
David L. Gummer & Kelley J. Kissner

Olive-backed Pocket Mouse ***(Perognathus fasciatus)*** 71
David L. Gummer & Kelley J. Kissner

Richardson's Ground Squirrel (***Spermophilus richardsonii)*** 76
Brad A. Downey

Swift Fox ***(Vulpes vulpes)*** 82
Brad A. Downey

Western Small-footed Myotis ***(Myotis ciliolabrum ciliolabrum)*** 90
Julie P. Landry

Amphibians and Reptiles

Great Plains Toad ***(Bufo cognatus)*** 99
Brad N. Taylor

Plains Spadefoot ***(Spea bombifrons)*** 106
Brad N. Taylor

Prairie Rattlesnake ***(Crotalus viridis)*** 112
Kelley J. Kissner

Short-horned Lizard ***(Phrynosoma hernandesi hernandesi)*** 125
Brad N. Taylor

Invertebrates

Weidemeyer's Admiral ***(Limenitis weidemeyerii)*** 132
Brad N. Taylor

APPENDICES

Appendix A - Potential habitat for burrowing owls within the Milk River Basin 19
Appendix B - Potential habitat for ferruginous hawk within the Milk River Basin 27
Appendix C - Potential habitat for loggerhead shrike within the Milk River Basin 35
Appendix D - Potential habitat for long-billed curlew within the Milk River Basin 41
Appendix E - Potential habitat for prairie falcon within the Milk River Basin 46
Appendix F - Histograms of sharp-tailed grouse habitat variables for occupied sites and available sites 53
Appendix G - Potential habitat for the sharp-tailed grouse within the Milk River Basin 54
Appendix H - Potential habitat for Sprague's pipit within the Milk River Basin 63
Appendix I - Potential habitat for American badger within the Milk River Basin 70
Appendix J - Potential habitat for Richardson's ground squirrel within the Milk River Basin 81
Appendix K - Potential habitat for swift fox within the Milk River Basin 89
Appendix L - Potential habitat for western small-footed myotis within the Milk River Basin 98
Appendix M - Potential habitat for great plains toad within the Milk River Basin 105
Appendix N - Potential habitat for plains spadefoot within the Milk River Basin 111
Appendix O - Potential habitat for prairie rattlesnake within the Milk River Basin 123
Appendix P - Potential habitat for short-horned lizard within the Milk River Basin 130
Appendix Q - Potential habitat for Weidemeyer's admiral within the Milk River Basin 135

LIST OF TABLES

Table 1.1 Model variables available for selection during the development of the 17 habitat suitability index models for the Milk River Basin project area 4
Table 1.2 Selected management species for MULTISAR: the Milk River Basin Project 10
Table 1.3 Species excluded from Milk River basin modeling process 11
Table 2.1 Soil texture classifications 15
Table 3.1 Soil texture classifications 23
Table 8.1 Nest characteristics of Sprague's pipit nest sites (n=47) in Saskatchewan (Sutter 1997) 56
Table 9.1 Soil texture classifications 66
Table 11.1 Soil texture classifications 78
Table 12.1 Soil texture classifications 85
Table 14.1 Soil texture classifications 101
Table 15.1 Soil texture classifications 107

LIST OF FIGURES

Figure 1.1 Habitat suitability index for native prairie cover class for the sharp-tailed grouse HSI model 3
Figure 2.1 Habitat suitability index for native prairie coverage class for the burrowing owl 15
Figure 2.2 Habitat suitability index for soil texture for the burrowing owl 15
Figure 2.3 Habitat suitability index for shrub/tree cover for the burrowing owl 16
Figure 2.4 Habitat suitability index for distance from linear disturbance for the burrowing owl 16
Figure 3.1 Habitat suitability index for native prairie class for the ferruginous hawk 22
Figure 3.2 Habitat suitability index for soil texture classification for the ferruginous hawk 23
Figure 4.1 Habitat suitability index for shrub coverage for the loggerhead shrike 30
Figure 4.2 Habitat suitability index for graminoid coverage for the loggerhead shrike 30
Figure 4.3 Habitat suitability index for slope for the loggerhead shrike 31
Figure 4.4 Habitat suitability index for farmyards for the loggerhead shrike 31
Figure 5.1 Habitat suitability index for graminoid coverage for the long-billed curlew. 37
Figure 5.2 Habitat suitability index for percent shrub coverage for the long-billed curlew. 38
Figure 5.3 Habitat suitability for slope for the long-billed curlew. 38
Figure 6.1 Habitat suitability index for slope for the prairie falcon 43
Figure 6.2 Habitat suitability index for forage for the prairie falcon 44
Figure 7.1 Habitat suitability index for native prairie cover class for the sharp-tailed grouse 50
Figure 7.2 Habitat suitability index curve for percent shrub cover for the sharp-tailed grouse 50
Figure 8.1 Habitat suitability index for percent native grass coverage for the Sprague's pipit 58
Figure 8.2 Habitat suitability index for percent tree and shrub cover for the Sprague's pipit 58
Figure 8.3 Habitat suitability index for riparian areas for the Sprague's pipit 59
Figure 9.1 Habitat suitability index for soil texture for the American badger 66
Figure 9.2 Habitat suitability index for graminoid coverage for the American badger 67
Figure 9.3 Habitat suitability index for slope for the American badger 67
Figure 9.4 Habitat suitability index for the American badger 68
Figure 10.1 Soil texture habitat suitability index for the olive-backed pocket mouse 73
Figure 10.2 Percent barren ground habitat suitability index for the olive-backed pocket mouse 73
Figure 10.3 Percent graminoid coverage habitat suitability index for the olive-backed pocket mouse 73
Figure 10.4 Percent shrub coverage habitat suitability index for the olive-backed pocket mouse 74
Figure 10.5 Habitat type suitability index for the olive-backed pocket mouse 74
Figure 11.1 Graminoid coverage habitat suitability index for the Richardson's ground squirrel 77
Figure 11.2 Slope habitat suitability index for the Richardson's ground squirrel 78
Figure 11.3 Soil Texture habitat suitability index for the Richardson's ground squirrel 79
Figure 11.4 Shrub and tree coverage habitat suitability index for the Richardson's ground squirrel 79
Figure 12.1 Shrub coverage habitat suitability index for the swift fox 84
Figure 12.2 Habitat suitability index for degrees slope for the swift fox. 84
Figure 12.3 Native prairie graminoid coverage habitat suitability index for the swift fox. 85

Figure 12.4 Soil texture habitat suitability index for the swift fox 86
Figure 13.1 Slope habitat suitability index for the western small-footed myotis 94
Figure 13.2 Land cover habitat suitability index for the western small-footed myotis 94
Figure 13.3 Distance to water habitat suitability index for the western small-footed myotis 95
Figure 14.1 Great plains toad 1st soil order class habitat suitability histogram 100
Figure 14.2 Great plains toad 2nd soil order class habitat suitability histogram 101
Figure 14.3 Great plains toad soil texture class habitat suitability histogram 101
Figure 14.4 Great plains toad native prairie class habitat suitability histogram 102
Figure 15.1 Plains spadefoot soil texture classification habitat suitability histogram 108
Figure 15.2 Plains spadefoot native prairie habitat suitability histogram 108
Figure 16.1 Distance from major river, coulee, or drainage for winter habitat suitability index for the prairie rattlesnake 114
Figure 16.2 Slope class habitat suitability index for the prairie rattlesnake 115
Figure 16.3 Slope stability habitat suitability index for the prairie rattlesnake 115
Figure 16.4 Aspect for winter habitat suitability index for the prairie rattlesnake 115
Figure 16.5 Landscape model habitat suitability index for the prairie rattlesnake 116
Figure 16.6 Distance from major river, drainage or coulee for summer habitat suitability index for the prairie rattlesnake 116
Figure 16.7 Road density habitat suitability index for the prairie rattlesnake 117
Figure 16.8 Road type habitat suitability index for the prairie rattlesnake 117
Figure 16.9 Native prairie class habitat suitability index for the prairie rattlesnake 118
Figure 16.10 Human population habitat suitability index for the prairie rattlesnake 118
Figure 16.11 Shrub/tree cover habitat suitability index for the prairie rattlesnake 118
Figure 16.12 Distance from major river, drainage or coulee for rookery habitat suitability index for the prairie rattlesnake 119
Figure 16.13 Aspect for rookery habitat suitability index for the prairie rattlesnake 119
Figure 16.14 Shrub cover for rookery habitat suitability index for the prairie rattlesnake 120
Figure 16.15 Bare rock cover habitat suitability index for the prairie rattlesnake 120
Figure 16.16 Elevation habitat suitability index for the prairie rattlesnake 121
Figure 17.1 Topographical habitat suitability index for the short-horned lizard 125
Figure 17.2 Habitat suitability index for native prairie for the short-horned lizard 126
Figure 17.3 Habitat suitability index for elevation for the short-horned lizard 126
Figure 17.4 Habitat suitability index for percent riparian features for the short-horned lizard 127
Figure 18.1 Habitat suitability index for topographical features for the Weidemeyer's admiral 132
Figure 18.2 Habitat suitability index for percent shrub cover for the Weidemeyer's admiral 133

ACKNOWLEDGEMENTS

Funding for MULTISAR: the Milk River Basin Project was provided through the Government of Canada Habitat Stewardship Program for Species at Risk, Alberta Fish and Wildlife Species at Risk Program, and the Alberta Conservation Association.

Richard Quinlan (Alberta Fish and Wildlife Division - AFWD) and Paul Jones (Alberta Conservation Association - ACA) developed, coordinated, supervised and administered MULTISAR: the Milk River Basin Project. Several people had a lead role in the compilation of habitat suitability index models for this project, including Brad Taylor, Brad Downey, Julie Landry, Paul Jones, Corey Skiftun (all of ACA), Kelley Kissner (AFWD), Brandy Downey (AFWD) and David Gummer (Provincial Museum of Alberta).

Thanks to Kathryn Romanchuk (AFWD) for her tireless efforts in editing the individual HSI models. Oriano Castelli (Alberta Sustainable Resource Development – Resource Information Unit) carried out an initial literature search, which was very helpful in preparation of several of the models. Vernon Remesz (ASRD) and Oriano Castelli produced the individual model maps and tables, which are key to the future of the project. Model preparation included consultation with several experts:

- Ursula Banasch (Canadian Wildlife Service)
- Dr. Robert Barclay (University of Calgary)
- Ron Bjorge (AFWD)
- Doug Collister (Ursus Ecosystem Management Ltd.)
- Andy Didiuk (Canadian Wildlife Service)
- Reg Ernst (Range Ecologist)
- Ed Hofman (AFWD)
- Shane Roersma (Lethbridge Community College)
- Pat Fargey (Grasslands National Park)
- Norbert Kondla (British Columbia Fish and Wildlife)
- Cori Lausen (University of Calgary)
- Dr. Gail Michener (University of Lethbridge)
- Joel Nicholson (AFWD)
- Dale Paton (Anatum Ecological Consulting)
- Dr. Dave Prescott (AFWD)
- Dr. Joseph Schmutz (University of Saskatchewan)
- Dr. Arlen Todd (AFWD)

MULTISAR: the Milk River Basin Project is a collaborative effort of three agencies and many other participants. It is succeeding because of the co-operative teamwork of all partners. This demonstrates a special open - minded attitude that goes beyond commitment and pride in any one organization, and is indicative of a desire in our society for multi-species and landscape-level conservation.

1.0 INTRODUCTION

MULTISAR: The Milk River Basin Project is an innovative approach to multi-species management in southern Alberta. The Milk River Basin was chosen as Alberta's first multi-species landscape management initiative based on the high number of sensitive, at risk, and may be at risk species combined with the small area that the basin encompasses. The project outlines a process to provide appropriate management on critical parts of the landscape to achieve multi-species conservation. It also emphasizes voluntary stewardship activities, and cooperation between conservation groups and private landowners to achieve conservation of multiple species.

In order to prioritize the landscape for conservation and stewardship initiatives it is first necessary to identify important landscape and habitat features for wildlife. This will be accomplished through species inventories and Habitat Suitability Index (HSI) models, which outline key habitat for selected species. Seventeen HSI models were created for the MULTISAR project, five of which were published in the 2003 report titled: *A Multi-Species Conservation Strategy for Species at Risk in the Milk River Basin: Year 1 Progress Report* (Quinlan et al. 2003). The five models included in the Year 1 progress report as well as the 10 previously unpublished models, found in *A Multi-species Conservation Strategy for Species at Risk in the Milk River Basin: Habitat Suitability Models for Selected Wildlife Management Species Interim Report* (Jones et al. 2003), are included in this final report. Two other models, swift fox (*Vulpes vulpes*) and long-billed curlew (*Numenius americanus),* are also included in this report and are preliminary models.

Though reviewed by experts, models should be treated as "preliminary" until field validated. Efforts will be made in the upcoming years to validate models through inventories of the specific species. In the interm the models will be used to prioritize the landscape for stewardship activities, commencing in 2004.

2.0 HABITAT SUITABILITY INDEX MODEL BACKGROUND

Paul F. Jones
Alberta Conservation Association, Lethbridge, AB

With increasing demands on resource development, resource managers face the challenge of maintaining wildlife habitat requirements while making land use decisions. Since the 1970's, several modeling techniques have been developed to aid in making decisions regarding land use and the protection of wildlife habitat (Berry 1986). One technique has been the development of single-species models (Berry 1986). Habitat suitability index (HSI) models were developed by the U.S. Fish and Wildlife Service as part of the habitat evaluation procedures (HEP) to assess the environmental impacts of proposed water and land resource development projects (USDI Fish and Wildlife Service 1981, Cole and Smith 1983, Bart *et al.* 1984, Berry 1986).

HSI models are designed as planning tools for situations where habitat conditions are expected to change, and are a means of assessing the changes in habitat quality and quantity for selected wildlife species (Schamberger and O'Neil 1986, Morrison *et al.* 1992). The models are hypothetical in nature, as they are derived from quantitative accounts and expert opinion regarding a species' habitat preferences (Bart *et al.* 1984, Brennan *et al.* 1986, Morrison *et al.* 1992). Habitat suitability index models work by evaluating habitat components from 0 to 1, where a rating of 1 is considered optimal habitat and a rating of 0 as least suitable habitat (USDI Fish and Wildlife Service 1981, Wisdom *et al.* 1986). Each component is then combined into an overall habitat suitability value for that area.

3.0 MODEL DEVELOPMENT

3.1 Background

The HSI modeling approach was selected for application within MULTISAR: The Milk River Basin project area. The approach used in the project was not to track changes in habitat for the selected species (Schamberger and O'Neil 1986, Morrison *et al.* 1992), but instead to predict potential habitat. The goal was to predict where potential habitat is located for each individual species modeled, and then combine the individual ratings into an overall rating. The overall rating is to be used to prioritize stewardship activities by identifying "hot spots" within the Milk River Basin. Hot spots are defined as areas of high habitat potential for more than one species.

Habitat suitability index models were developed for 17 species in the Milk River Basin project area in 2002 / 2003. All species are considered Species at Risk (SAR), with classifications ranging from "Sensitive" to "At Risk," except the Richardson's ground squirrel (*Spermophilus richardsonii*) which is classified as "Secure" (Alberta Sustainable Resource Development 2001). Alberta Conservation Association, Alberta Fish and Wildlife, and Provincial Museum of Alberta staff developed models, with support from the Alberta Resource Data Division. A workshop was held for those developing models to review the modeling process and provide feedback on preliminary models. Where applicable, experts were consulted during model development. Several models were modified to take into consideration local habitat inventory data available within the basin based on the Biodiversity Species Observation Database (BSOD). The models, which incorporated BSOD data, included loggerhead shrike, great plains toad, plains spadefoot, short-horned lizard, prairie rattlesnake, swift fox, sharp-tailed grouse and the prairie falcon. All models were developed for application within the Milk River Basin at a landscape level, so application outside of this area or for site-specific analysis may not be valid.

3.2 Model Variables

HSI models estimate the value of habitat for wildlife by relating structural and spatial variables of vegetation to particular life requirements (*i.e.* food and cover) (USDI Fish and Wildlife Service 1981, Bessie *et al.* 1996). Habitat variables are the building blocks of an HSI model; the variables are selected from available databases and are chosen based on their ability to represent important habitat features for a selected species. Each variable chosen must be measurable using available map bases and are generally physical, chemical, or biological characteristics of the habitat (USDI Fish and Wildlife Service 1981, Bessie *et al.* 1996). Spatial variables are used to modify available habitat and take the form of distance to or from a particular feature (*e.g.* distance from roads). Spatial variables were measured through the use of geographic information systems (GIS's) (Bessie *et al.* 1996). During model development each habitat variable is separated into components to the point that each component is related and measurable. For example, in the sharp-tailed grouse model the variable native prairie cover (NPC) is used. It is broken down into its components (*i.e.* classes 1 – 5) with each class being assigned an HSI value (Figure 1.1). A graphic relationship is determined for each variable on a scale of 0 to 1, zero representing least suitable habitat and 1 representing optimum habitat (USDI Fish and Wildlife Service 1981).

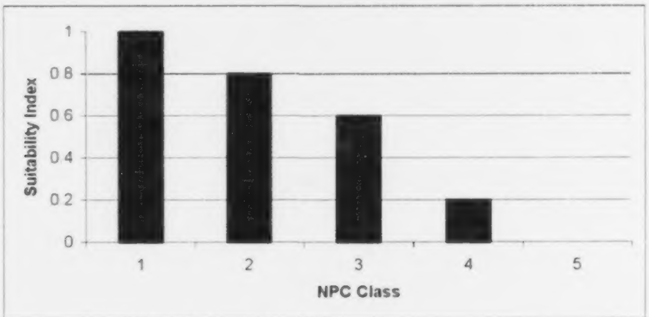


Figure 1.1 Habitat suitability index for native prairie cover class for the sharp-tailed grouse HSI model

A total of 13 structural variables and 2 spatial variables were chosen for constructing the 17 HSI models (Table 1.2). The selection of variables was governed by available databases. Variables selected in the modeling process for MULTISAR: the Milk River Basin Project were derived from four available databases: the Native Prairie Vegetation Inventory (NPVI)(Resource Data Branch 1995), Agricultural Region of Alberta Soil

Inventory Database (Version 3.0) (AGRASID) (Alberta Soil Information Centre 2001), Digital Elevation Model (DEM), and Provincial Base Features (provided by Spatial Data Warehouse).

The NPVI is a database developed by conducting an inventory at the resolution of a quarter section using 1991 – 1993 1:30,000 aerial photography (Resource Data Branch 1995). Native vegetation was classified as either tree, shrub, graminoid (grass), riparian, lake, or wetland to the nearest 5% of each quarter section (Resource Data Branch 1995). AGRASID is a database that portrays the spatial distribution of Alberta's soils and associated landscapes in the agricultural or white zone. The five components that make up AGRASID 3.0 include an Agricultural Region of Alberta Soil Inventory Database, a Basic Soil Evidence File, Soil Names File, a Soils Layer File, and a Land System Legend table. The projection used to portray AGRASID was Ten-Degree Transverse Mercator (NAD83) with a false Easting of 500,000 meters. The fields within NPVI and AGRASID databases constitute the bulk of the structural variables used in the models.

The construction of the models was limited to the available variables and resolution of the databases. For MULTISAR: the Milk River Basin Project area this was the quarter section, the resolution of the Native Prairie Vegetation Inventory. Because of the resolution of available databases, the models produced for this project are coarse in nature. Each HSI model chapter discusses the limitations of available databases and its effect on model development. Certain variables (*e.g.* single tree cover for ferruginous hawk) were omitted from these models that likely would have been included in more fine grain (*i.e.* site- specific) models.

Table 1.1 Model variables available for selection during the development of the 17 habitat suitability index models for the Milk River Basin project area

Variable	Units	Source*	Resolution
Structural			
Native Prairie Cover	Categorical	NPVI	Quarter section
Grass Cover	Percentage	NPVI	Quarter section
Shrub Cover	Percentage	NPVI	Quarter section
Tree Cover	Percentage	NPVI	Quarter section
Riparian	Percentage	NPVI	Quarter section
Lake	Percentage	NPVI	Quarter section
Soil Texture	Categorical	AGRASID	25 meter
First and Second Order Soil Classification	Categorical	AGRASID	25 meter
Badlands (shallow to gravel)	Categorical	AGRASID	25 meter
Valleys	Categorical	AGRASID	25 meter
Elevation	Meter	DEM	25 meter
Slope	Degrees	DEM	25 meter
Aspect	Categorical	DEM	25 meter
Spatial			
Distance to Access (roads)	Meter	PBF	5 – 20m
Distance to Hydro (rivers, water bodies)	Meter	PBF	5 – 20m

*NPVI - Native Prairie Vegetation Inventory
AGRASID - Agricultural Region of Alberta Soil Inventory Database
DEM - Digital Elevation Model
PBF - Provincial Base Features

3.3 Model Equations

Once the relationship has been determined for each variable, they are combined using a mathematical equation to produce the habitat suitability index. The index ranges from 0 to 1. The equation used to combine the variables must take into account how the species utilizes the different variables in its habitat (Bessie *et al.* 1996). Bessie *et al.* (1996) states that there are 3 guidelines used in determining the appropriate equation. First, the level of interaction between variables determines how they are combined (additive or multiplied). Secondly, one variable may compensate for another and determines whether one variable increases the effect of another. Lastly, different weightings can be applied to certain variables to reflect their importance. Basic equations used to combine the variables are:

Cumulative Relationship (Additive) - simply sums the values of two or more variables, where a threshold may be met by one or a combination of variables. This formula is used when there is no interaction between variables and the total cannot exceed 1 (Bessie *et al.* 1996).

$$HSI=V_1+V_2+V_3 \text{ (max. value of 1).}$$

Complete Interaction (Multiply) – occurs when there is complete interaction of all variables. This equation will result in 0 if one variable is rated 0, and the index value gets increasingly higher as each variable approaches 1 (Bessie *et al.* 1996).

$$HSI= V_1*V_2*V_3$$

Limiting Factors (Minimum Function) - a variable with lowest suitability overrides all other factors and is often used when more than one model is developed for different life requisites (*e.g.* food, shelter, nesting). For example, if HSI models were constructed for the life requisites of food, hiding cover and thermal cover and had values of 1.0, 0.5 and 0.25 respectively, the overall model would have an HSI value of 0.25.

$$HSI= \text{minimum } (V_1, V_2, V_3).$$

Compensatory Relationships - when a variable with low value is offset by high suitability of other variables. Compensatory relationship equations can take the form of the arithmetic mean or the geometric mean (Bessie *et al.* 1996). The arithmetic mean is used when variables can be combined but all are not required to have suitable habitat.

$$HSI=(V_1+V_2+V_3)/n.$$

The geometric mean is used when a value of 0 for any variable results in an overall value of 0. The geometric mean will result in a lower overall value than the arithmetic mean.

$$HSI=(V_1*V_2*V_3)^{1/n}$$

4.0 MODEL APPLICATION

The HSI models developed during this project are to be used in a planning exercise to prioritize the landscape within the MULTISAR project area for future stewardship activities. Individual HSI models will be mapped to provide a visual display of relative habitat for the species in the Milk River Basin. Species at risk conservation priority "hot spots" will be identified where overlaps of high HSI values for several species occur (Jones and Downey 2004).

5.0 LITERATURE CITED

Alberta Soil Information Centre. 2001. AGRASID3.0: Agricultural Region of Alberta Soil Inventory Database (Version 3.0). Edited by J.A. Brierley, T.C. Martin, and D.J. Spiess. Agriculture and Agri-Food Canada, Research Branch; Alberta Agriculture, Food and Rural Development, Conservation and Development Branch. Available: http://www1.agric.gov.ab.ca/soils/soils.nsf

Alberta Sustainable Resource Development. 2001. The General Status of Alberta Wild Species 2000. Alberta Sustainable Resource Development, Fish and Wildlife Service, Edmonton, AB. 46 pp. Publ. No. I/023.

Bart, J., D.R. Petit, and G. Linscombe. 1984. Field evaluation of two models developed following the habitat evaluation procedures. Transactions of the North American Wildlife and Natural Resources Conference 49: 489-499.

Berry, K.H. 1986. Introduction: development, testing, and application of wildlife-habitat models. Pp. 3-10 IN: Verner, J. *et al.* (eds.). Wildlife 2000: modeling habitat relationships of terrestrial vertebrates. University of Wisconsin Press, Madison, Wisconsin.

Bessie, W., B. Beck, J. Beck, R. Bonar, and M. Todd. 1996. Development and use of HSI models. Pp. 1-9 IN: B. Beck, J. Beck, W. Bessie, R. Bonar, and M. Todd. (eds.). Habitat suitability index models for 35 wildlife species in the foothills model forest. Foothills Model Forest, Hinton, Alberta, Canada.

Brennan, L.A., W.M. Block, and R.J. Gutierrez. 1986. The use of multivariate statistics for developing habitat suitability index models. Pp. 177-182 IN: Verner, J. *et al.* (eds.). Wildlife 2000: modeling habitat relationships of terrestrial vertebrates. University of Wisconsin Press, Madison, Wisconsin.

Cole, C.A., and R.L. Smith. 1983. Habitat suitability indices for monitoring wildlife populations - an evaluation. Transactions of the North American Wildlife and Natural Resources Conference 48: 367-375.

Jones, P.F. B. A. Downey, B. N. Taylor, J. P. Landry, R. W. Quinlan, K. J. Kissner, C. L. Skiftun, and D. L. Gummer. 2003. A Multi-Species Conservation Strategy For Species at Risk in the Milk River Basin: Habitat Suitability Models for Selected Wildlife Management Species. Unpublished report. Alberta Conservation Association and Alberta Fish and Wildlife Division. Lethbridge, Alberta. 118 pp.

Jones, P.F. and B.L. Downey. 2004. Multi-species conservation value, in Quinlan, R.W., B.A. Downey, B.L. Downey, P.F. Jones and T.B. Clayton (eds.). 2004. A multi-species conservation strategy for species at risk in the Milk River Basin: year 2 progress report. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Report, in press.

Morrison, M.L., B.G. Marcot, and R. W. Mannan. 1992. Wildlife-habitat relationships: concepts and applications. The University of Wisconsin Press, Madison, Wisconsin. 343 pp.

Quinlan, R.W., B.A. Downey, B.N. Taylor, P.F. Jones, and T.B. Clayton (eds.). A multi-species conservation strategy for species at risk in the Milk River basin: year 1 progress report. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Report No. 72, Edmonton, AB. 229 pp.

Resource Data Branch. 1995. Native Prairie Vegetation Inventory (Grassland Natural Region). Alberta Sustainable Resource Development.

Schamberger, M.L. and L.J. O'Neil. 1986. Concepts and constraints of habitat-model testing. Pp. 5-10 IN: Verner, J. *et al.* (eds.). Wildlife 2000: modeling habitat relationships of terrestrial vertebrates. University of Wisconsin Press, Madison, Wisconsin.

USDI Fish and Wildlife Service. 1981. Standards for the development of suitability index models. U.S. Fish and Wildlife Service, Division of Ecological Services, Washington, D.C., Ecological Services Manual 103.

Wisdom, M.J., L.R. Bright, C.G. Carey, W.W. Hines, R.J. Pedersen, D.A. Smithey, J.W. Thomas, and G.W. Witmer. 1986. A model to evaluate elk habitat in Western Oregon. United States Department of Agriculture, Forest Service Pub. No. R6-F&WL-216-1986. 36 pp.

6.0 SPECIES SELECTION

Richard W. Quinlan
Alberta Sustainable Resource Development, Fish and Wildlife Division, Lethbridge, AB

Under ideal circumstances, each organism present in the Milk River Basin would warrant having populations inventoried and habitat mapped. This, however, would be impractical due to limitations of budget, staffing, and time. Traditionally, wildlife managers have carried out inventory and management of game species. With increased concern about species declines, the list of priority management species has expanded to include species considered to be sensitive, may be at risk, or at risk. In recent years there have also been attempts to develop management systems based upon biodiversity. While this project strives to include key landscape processes, a comprehensive model of biodiversity is not within the scope of this project. Such models are dynamic in time and space, and very complex (Salwasser 1986). They may be useful for maintaining large habitat types on the landscape, but are likely unreliable for management of species already documented to be in decline, or those with particular sensitivities to habitat variables below the large landscape level.

Multi-species management approaches have been developed, including systems based on guilds (Sveringhaus 1981). A guild is defined as "a group of species that exploit the same class of environmental resources in a similar way. This term groups together species that overlap significantly in their niche requirements" (Root 1967). Thomas (1979) grouped species into "life forms" based on habitats used for breeding and feeding. Systems based solely upon these approaches may not achieve an objective of successful ecosystem management (Verner 1984). The use of indicator species to predict the responses of other species has been criticized due to the large numbers of variables to be considered (Morrison *et al.* 1992). Extrapolation beyond primary species also presents mapping difficulties due to overlaps of species between guilds and life forms (Bonar *et al.* 1990).

MULTISAR: The Milk River Basin Project's primary goal is to maintain habitat and populations of species at risk. A review has been made of important natural processes, their importance to the selected management species, and the status of these processes within the basin. This allows for some interpretation to the landscape level, and ameliorates the previously cited weaknesses of single and multiple-species approaches.

Through selection of species with a wide spectrum of habitat associations, and subsequent management for them, it is possible that other species with similar habitat associations will also benefit, but this is not measurable. A species selection criterion has been adopted which may increase the likelihood of other species with similar niches being managed for under this project. Each species model includes mention of other species that are believed to exhibit similar habitat use characteristics during critical life stages. This is not, however, being portrayed as an evaluation beyond the species selected, as this would be fraught with inherent error.

For MULTISAR: the Milk River Basin Project high priority management species (At Risk, May be at Risk, Sensitive) were selected for model development based on having high ecological importance as determined by one or more criteria (Landres *et al.* 1988, Morrison *et al.* 1992, Thomas and Verner 1986). Primary criteria for species selection included:

- Strong representative of a group of species with similar habitat associations.
- Strong association with a specific major ecosystem (*e.g.* native grasslands).
- Strong association with specific habitat structures (*e.g.* cliffs).
- Narrow ecological tolerances.
- High sensitivity to habitat changes and human activities.
- Value as a "keystone species" (*e.g.* important prey species).

Further modification of the list of selected species was done through consideration of the availability of information for species, a desire for proportionate representation amongst major taxa, documented declines in other jurisdictions, and comparative ease of inventory and monitoring. A list of selected management species for MULTISAR: the Milk River Basin Project is included in Table 1.2.

Additional species were considered for model development, but were excluded for a variety of reasons. Two of these, the swift fox and long-billed curlew, were selected later in the process, and were included in the HSI model development in 2003-2004. A list of excluded species and associated reasons is included in Table 1.3.

MULTISAR: The Milk River Basin Project is primarily designed to maintain habitat for species at risk through application of landscape-level management. The selection of appropriate species, development of habitat suitability index models for them, and mapping of relative habitat values throughout the basin will help to determine landscape "hot spots" of suitability for selected species at risk. The use of habitat variables and thresholds present in the Prairie Unit's Resource Information Branch's ArcView files has allowed for mapping of habitat across the Milk River Basin.

Table 1.2 Selected management species for MULTISAR: the Milk River Basin Project

Species	Justification	Range in Milk River Basin
Ferruginous Hawk	Native grasslands association, dependent on keystone prey, sensitive, recent inventory	Throughout, but highest numbers in Milk River Ridge
Prairie Rattlesnake	Prairie coulees & grasslands association, sensitive	Throughout, highest in Writing-on-Stone and Lower Milk River
Great Plains Toad	Ephemeral ponds, narrow ecological tolerance, recent inventory	Lower Milk River and Lodge Creek
Short-horned Lizard	Prairie coulees & valley breaks, narrow ecological tolerance, recent inventory	Writing-on-Stone, Lower Milk River, and Lodge Creek
Weidemeyer's Admiral	Riparian shrub association	Writing-on-Stone
Sharp-tailed Grouse	Grassland/shrubland, current monitoring program	Throughout, but highest numbers in Milk River Ridge
Plains Spadefoot	Ephemeral ponds, recent inventory	Throughout, except Milk River Ridge Unit
Loggerhead Shrike	Shrub/grassland association	Throughout
Sprague's Pipit	Native grassland association, strong species group representative	Throughout
Burrowing Owl	Native grassland association, sensitive	Throughout
Badger	Native grassland, dependent on keystone prey, makes burrows for burrowing owls	Throughout
Prairie Falcon	Habitat structure association (cliffs)	Primarily Milk River Valley
Olive-backed Pocket Mouse	Grassland and sandy soil association	Unknown
Richardson's Ground Squirrel	Important prey for several species; keystone species	Throughout
Western Small-footed Myotis (Bat)	Riparian (cottonwood and cliffs) association	Throughout Milk River Valley

Table 1.3 Species excluded from Milk River basin modeling process

Species	**Reason for Excluding**
Western Silvery Minnow	Riverine, key variable flow rates which cannot be mapped
Brassy Minnow	Tributaries and mainstem, variables cannot be mapped
Sage Grouse	U of A research project underway includes development of habitat model. Specific recovery process already underway for this species, including conservation initiatives likely to occur within Milk River Basin.
Shorthead Sculpin	Riverine, key variable flow rates which cannot be mapped
Yucca/Yucca Moth	Very limited distribution already known and these species are already scheduled for specific recovery planning.
Western Blue Flag	Specific recovery initiatives are already underway through the Western Blue Flag Conservation Program.
Piping Plover	Few, very specific locations will receive site-specific management through the Piping Plover Recovery Plan.
Short-eared Owl	Insufficient information on habitat and distribution
Long-tailed Weasel	Insufficient information on habitat and distribution
Pronghorn	A separate management project includes the development of a habitat model that can be applied in the Milk River Basin.
Western Hog-nosed Snake	Insufficient information on habitat and distribution
Bullsnake	Insufficient information on habitat and distribution
Northern Leopard Frog	Extensive suitable habitat is vacant due to past declines; management recommendations will be made at known occurrence sites.
Western Painted Turtle	Very limited distribution

7.0 LITERATURE CITED

Bonar, R., R Quinlan, T. Sikora, D. Walker, and J. Beck. 1990. Integrated management of timber and wildlife resources on the Weldwood Hinton forest management agreement area. Alberta Department of Forestry, Lands, and Wildlife and Weldwood of Canada Limited. 44 pp.

Landres, P.B., J. Verner, and J.W. Thomas. 1988. Ecological uses of vertebrate indicator species: a critique. Conservation Biology 9l(2): 316-329.

Morrison, M.L., B.G. Marcot, and R.W. Mannan. 1992. Wildlife-habitat relationships, concepts and evaluations. Univ. Wisconsin Press. Madison. 343 pp.

Root, R.B. 1967. The niche exploitation patterns of the blue-gray gnatcatcher. Ecological Monographs 37: 317-350.

Salwasser, H. 1986. Modelling habitat relationships of terrestrial vertebrates, the manager's viewpoint. Pp. 419-424 IN: Verner, J., M.L. Morrison, and C.J. Ralph (eds.). Wildlife 2000, modelling habitat relationships of terrestrial vertebrates. Univ. Wisconsin Press. Madison. 470 pp.

Sveringhaus, W.D. 1981. Guild theory development as a mechanism for assessing environmental impact. Environ. Manage. 5: 187-190.

Thomas, J.W., editor. 1979. Wildlife habitats in managed forests in the Blue Mountains of Oregon and Washington. USDA Agric. Handb. 553. 512 pp.

Thomas, J.W., and J. Verner. 1986. Forests. Pp. 73-91 IN: Cooperrider, A.Y., R.J. Boyd, and H.R. Stuart, (eds.). Inventory and monitoring of wildlife habitat. U.S. Dept. Interior, Bur. Land Manage. 858 pp.

Verner, J. 1984. The guild concept applied to management of bird populations. Environ. Manage. 8: 1-14.

BURROWING OWL (*Athene cunicularia*)

Corey L. Skiftun
Alberta Conservation Association, Hanna, AB

1.0 PURPOSE AND LIMITATIONS

The purpose of this model is to indicate potential habitat for burrowing owls (*Athene cunicularia*) within the Milk River Basin. As this is a landscape level model with coarse variables, it may not be directly applicable to other areas or for site-specific analysis.

2.0 GENERAL INFORMATION

The burrowing owl populations of Alberta are sparsely distributed throughout the mixed grass and dry mixed grass ecoregions of Alberta (Scobie 1993, as cited in Wellicome 1997). The burrowing owl is listed as an "At Risk" species, with the 1995 population estimated at 700 to 900 breeding pairs and declining (Alberta Sustainable Resource Development 2001). The decline in burrowing owl populations has occurred since the mid 1900's when modern agricultural practices began (Hjertaas *et al.* 1995).

The adult burrowing owl can be identified by its small size (230-280 mm body length), long legs, dull brown body barred with buff and spotted white dorsally, and white to buff underparts barred with brown (Zarn 1974). Clutch size ranges from 6 to 11 eggs, with the young becoming independent between 60 and 70 days (Wellicome 1997). According to Wellicome (1997), burrowing owls return to Alberta in early April to early May, with the harshness of the weather being the main factor influencing return times.

3.0 GENERAL HABITAT ASSOCIATIONS

3.1 Cover

Burrowing owls require dry, open, short grass, treeless plains as nesting habitat (Salt and Salt 1976 and Godfrey 1986, as cited in Hjertaas *et al.* 1995). They do not excavate their own burrows, but rely on existing burrows created by ground squirrels (*Spermophilus* spp.), badgers (*Taxidea taxus*), and foxes (*Vulpes* spp.) (Wellicome 1997). Foraging habitat characteristics differ from nesting habitat. Haug and Oliphant (1990, as cited in Wellicome and Haug 1994) found most foraging was done in areas where vegetation heights were greater than 30 cm, including right of ways and uncultivated areas.

3.1.1 Nesting Habitat

Soil types play a role in the nesting habitat of burrowing owls. Harris and Lamont (1985, as cited in Wellicome 1997) indicated that burrowing owl densities on lacustrine systems were five times higher than those found on solonetzic soils, which was the second most selected land system. MacCracken (1985, as cited in Hjertaas *et al.* 1995) determined that nest burrows occurred in soils with greater sand content than burrows not containing nests. Dechant *et al.* (2001) found burrowing owl nests in the following soil types: loamy sand, silty loam, silty clay loam, and sandy loam. They discovered that of 85 nests found in loamy sands, 46 % tended to silt after one year, whereas, of 13 nest burrows found in silty loam soils, none had silted in within a year.

Habitat fragmentation reduces the number of suitable nesting sites, resulting in small pastures having greater burrowing owl densities than larger pastures (James 1993, as cited in Wellicome and Haug 1994). Increased densities can lead to an increase in intraspecific competition (Saunders *et al.* 1991), resulting in high nest abandonment and low productivity (Green and Anthony 1989, as cited in Wellicome and Haug 1994).

3.2 Food

Johnsgard (1988, as cited in Hjertaas *et al.* 1995) reported that burrowing owl prey is varied, consisting of: grasshoppers, beetles, crickets, locusts, dragonflies, mice, voles, rats, ground squirrels, gophers, chipmunks, shrews, young prairie dogs, toads, frogs, salamanders and grassland birds. The time of year greatly influences the major prey species, with 93% of the prey being invertebrates in the summer and small mammals being the primary food source in the spring and fall (Haug 1985, as cited in Hjertaas *et al.* 1995).

4.0 HABITAT AREA REQUIREMENTS

Haug and Oliphant (1990, as cited in Wellicome and Haug 1994) found that the foraging home range size for six male burrowing owls averaged 2.41 km^2, with the maximum distance from the nest averaging 1.73 km.

5.0 ASSOCIATED SPECIES

Aside from relying on other species to excavate their burrows, burrowing owls serve as prey for the following species: skunks (*Mephitis mephitis*), badgers, coyotes (*Canis latrans*), prairie falcons (*Falco mexicanus*), red-tailed hawks (*Buteo jamaicensis*), Swainson's hawks (*B. swainsoni*), ferruginous hawks (*B. regalis*), northern harriers (*Circus cyaneous*), golden eagles (*Aquila chrysaetos*), and great horned owls (*Bubo virginianus*) (Zarn 1974).

6.0 THE HSI MODEL

Due to limited available data, this model can only be used as a general habitat model. Information such as grass heights (important for determining both nesting and foraging habitat) and burrow availability have been used in other habitat suitability models, however that data was not obtainable. The habitat variables chosen for this model were native prairie coverage, soil texture, shrub/tree coverage, and distance from linear disturbances (roads).

6.1 Selected Habitat Variables

6.1.1 Native Prairie Coverage (V_1)

Because burrowing owls require short grass habitat for nesting and subsequent reproduction, native prairie coverage was considered the most critical variable in determining the most suitable habitat. Hjertaas *et al.* (1995) indicated that intensified land use is believed to play a major role in the decline of burrowing owl populations. Native prairie coverage class illustrates the percentage of the quarter sections that are still native prairie, indicating the intensity of the land use. The higher the percentage of native prairie, the more suitable it is for burrowing owl habitat (Figure 4.1).

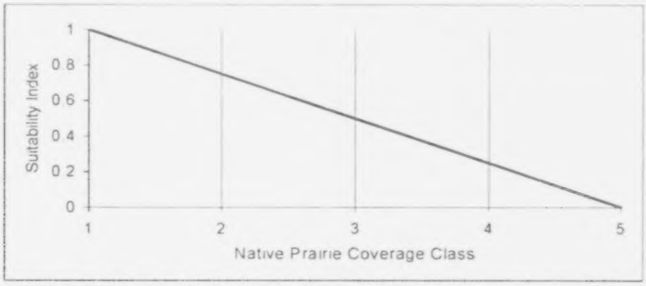


Figure 2.1 Habitat suitability index for native prairie coverage class for the burrowing owl

6.1.2 Soil Texture (V_2)

Soil texture affects burrow stability and therefore can be used to predict and assess possible nest and satellite burrows (burrows that are used other than their nest burrows.) in a given area (Figure 2.2)

Table 2.1 Soil texture classifications

Soil Texture Classification	Symbol	Soil Textures Included
Coarse	C	Sand, Loamy sand
Moderately Coarse	MC	Sandy loam
Medium	M	Loam, Silt loam, Silt
Moderately Fine	MF	Sandy clay loam, Silty clay loam, Clay loam
Fine	F	Sandy clay, Silty clay, Clay

Footnote 1- U.S. Department of Agriculture Classification System adapted from Brady and Weil (1999)

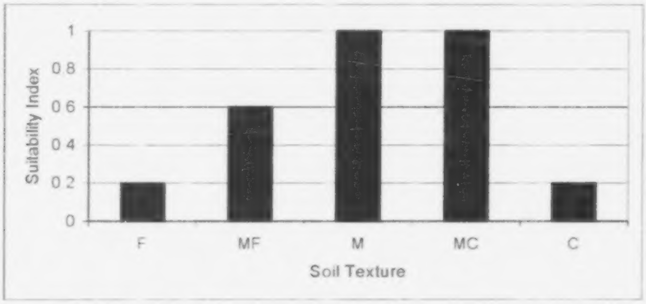


Figure 2.2 Habitat suitability index for soil texture for the burrowing owl

6.1.3 Shrub/Tree Coverage (V_3)

Burrowing owls require dry, open, short grass, treeless plains for nesting habitat (Salt and Salt 1976 and Godfrey 1986, as cited in Hjertaas *et al.* 1995). The amount of shrub/tree cover affects burrowing owls by limiting their line of sight, making them more susceptible to predators. Increased shrub/tree coverage can also provide perch sites for raptors that utilize burrowing owls as prey (Figure 2.3).

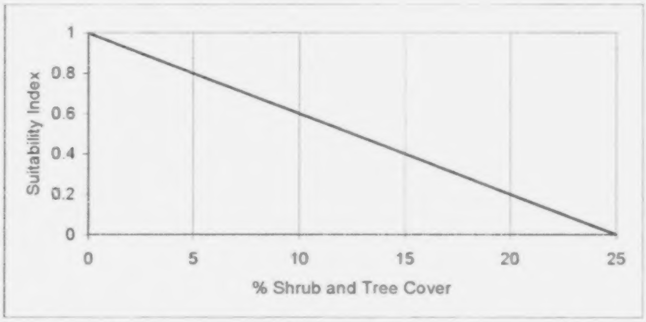


Figure 2.3 Habitat suitability index for shrub/tree cover for the burrowing owl

6.1.4 Distance From Linear Disturbances (Roadways) (V_4)

Burrowing owls will use right of ways to forage, making them susceptible to road mortality. Road mortality reported by Butts (1973, as cited in Hjertaas *et al.* 1995) and Haug (1985, as cited in Hjertaas *et al.* 1995) was noted as being substantial, however, a personal communication by K. Clayton to Wellicome (1997) indicated that vehicle mortality in Hanna, AB was small. For the purposes of this model, habitat suitability increases as the distance from linear disturbances (roadways) increases, given that owl/vehicle interactions would be less likely (Figure 2.4).

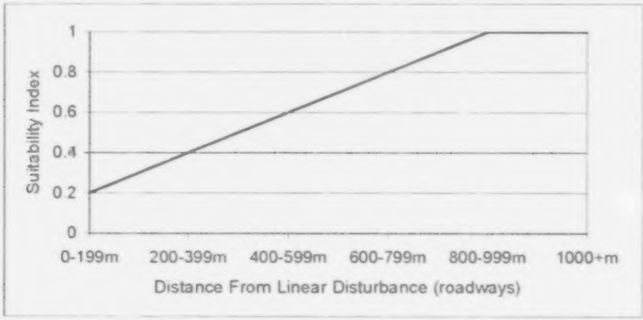


Figure 2.4 Habitat suitability index for distance from linear disturbance for the burrowing owl

7.0 HSI EQUATION

$$HSI = V_1 * ((V_2 + V_3 + .5V_4)/2.5))$$

Native prairie coverage (V_1) is the key factor in this formula so it is given its own full value. Soil texture (V_2), shrub/tree coverage (V_3), and distance from linear disturbance (V_4) are averaged and then multiplied by native prairie coverage to achieve the final HSI value. The V_4 variable (distance from linear disturbance) was given a weighting of 0.5 instead of its full value since it could be considered either a negative factor, as illustrated by road mortality, or regarded as beneficial for being used as hunting and foraging areas.

8.0. HABITAT SUITABILITY MAP

Please refer to Appendix A for the colour map, which indicates suitable habitat for the burrowing owl in the Milk River Basin. The majority of the highly suitable areas fall in the far eastern half of the basin with a few select areas also occurring in western parts of the basin. However these areas are not continuous and are divided by the distance to linear disturbance variable. The central section of the basin is ranked as least suitable for the owl predominantly due to the increased amount of cultivation, which occurs, in that area.

9.0 LITERATURE CITED

Alberta Sustainable Resource Development. 2001. The General Status of Alberta Wildlife Species 2000. Alberta Sustainable Resource Development, Fish and Wildlife Service, Edmonton, AB. 49 pp. Publ. No. I/023.

Butts, K. O. 1973. Life history and habitat requirements of Burrowing Owls in Western Oklahoma. Unpublished M.Sc. thesis, Oklahoma State University, Stillwater, OK. 188 pp.

Dechant, J. A., M. L. Sondreal, D. H. Johnson, L. D. Igl, C. M. Goldade, P. A. Rabie, and B. R. Euliss. 2001. Effects of management practices on grassland birds: Burrowing Owl. Northern Prairie Wildlife Research Center, Jamestown, ND. Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/resource/literatr/grasbird/buow/buow.htm.(Version 17FEB2000).

Godfrey, W. E. 1986. The birds of Canada. Rev.ed. National Museum of Natural Sciences, National Museums of Canada. Ottawa, Canada. 595 pp.

Green, G. A., and R. G. Anthony. 1989. Nesting success and habitat relationships of Burrowing Owls in the Columbia Basin, Oregon. Condor 91: 347-354.

Harris, W. C. and S. M. Lamont. 1985. Saskatchewan Burrowing Owls: breeding distribution and habitat utilization. Unpublished report by Prairie Environmental Services Inc. for the Saskatchewan Natural History Society and Saskatchewan Parks and Renewable Resources, Regina, Sk.

Haug, E. A. 1985. Observations on the breeding ecology of Burrowing Owls in Saskatchewan. Unpublished M.Sc. thesis, University of Saskatchewan, Saskatoon, SK. 89 pp.

Haug, E. A., and L. W. Oliphant. 1990. Movements, activity patterns, and habitat use of burrowing owls in Saskatchewan. J. Wildl. Manage. 54: 27-35.

Hjertaas, D. G., S. Brechtel, K. De Smet, O. Dyer, E. Haug, G. Holroyd, P. James, and J. Shmutz. 1995. National Recovery Plan of the Burrowing Owl. Report No.13. Ottawa: Recovery of Nationally Endangered Wildlife Committee. 33 pp.

James, P. C. 1993. Habitat fragmentation and Burrowing Owls in Saskatchewan. Pp.193-194 In: Proceedings of the third endangered species and prairie conservation workshop (Holroyd, G. L., H. L. Dickson, M. Regnier, and H. C. Smith, eds.) Natural History Occasional Paper No. 19. Provincial Museum of Alberta, Edmonton, AB.

Johnsgard, P. A. 1988. North American Owls, biology and natural history. Smithsonian Institution Press, Washington, D. C.

MacCracken, J. G., D. W. Uresk, and R. M. Hansen. 1985. Vegetation and soils of Burrowing Owl nest sites in Conata Basin, South Dakota. Condor 87: 152-154.

Salt, W. R. and J. R. Salt. 1976. The birds of Alberta. Hurtig Publishers, Edmonton, AB. 498 pp.

Saunders, D. A., H. J. Hobbs, and C. R. Margules. 1991. Biological consequences of ecosystem fragmentation: a review. Conservation Biology 5 (1): 18-27.

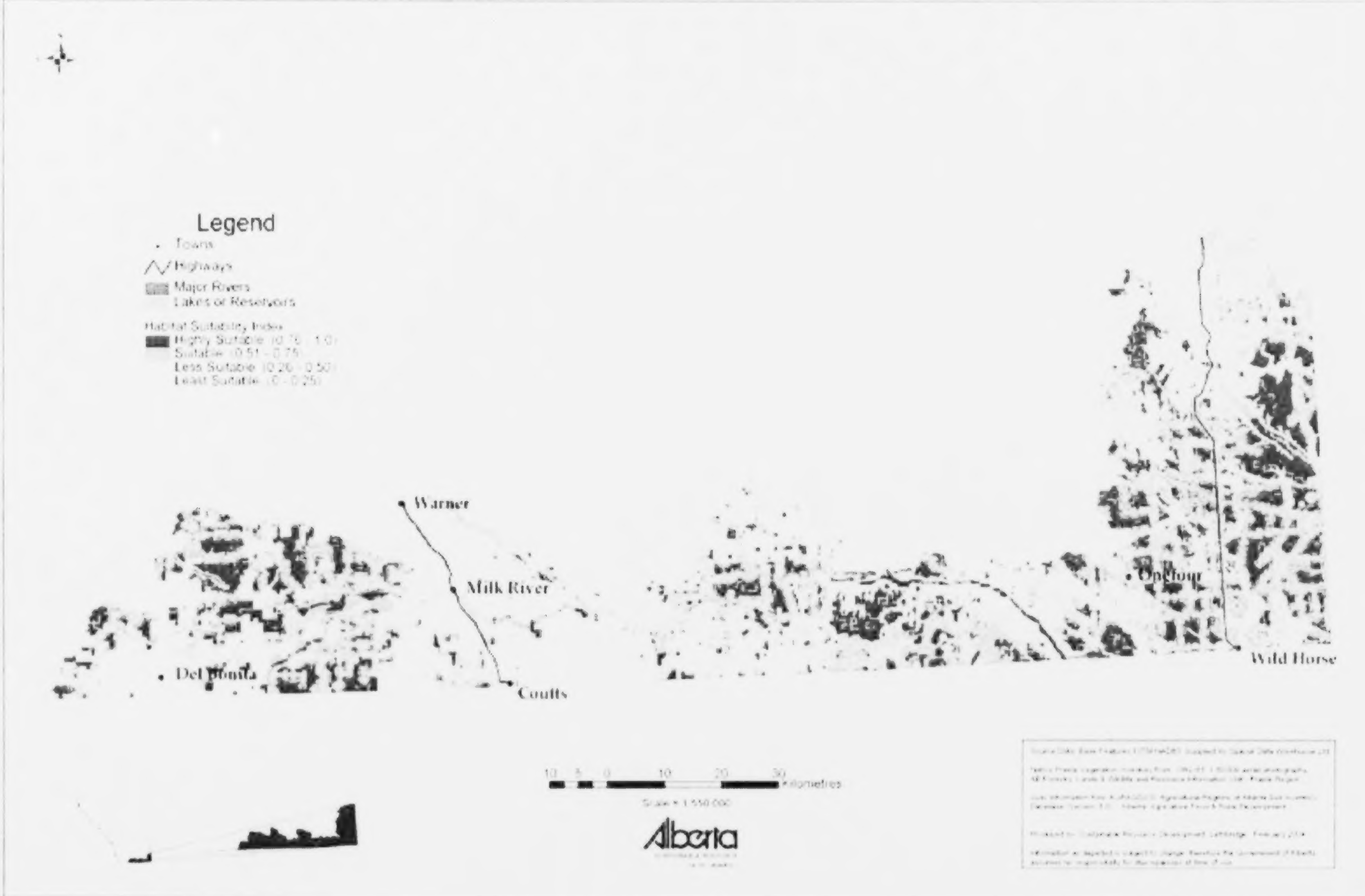
Scobie, D. 1993. Operation Burrowing Owl (Alberta): 1993 final report. Unpubl. report for Alberta Fish and Game Association, Edmonton, AB. 19 pp.

Wellicome, T. I. and E. A. Haug. 1994. Updated Report on the Status of the Burrowing Owl (*Speotyto cunicularia*) in Canada.

Wellicome, T. I. 1997. Status of the Burrowing Owl (*Speotyto cunicularia hypugaea*) in Alberta. Alberta Environmental Protection, Wildlife Management Division, Wildlife Status Report No. 11, Edmonton, AB. 21 pp.

Zarn, M. 1974. Burrowing Owl, report No. 11. Habitat management service for unique or endangered species. U.S. Department of the Interior, Bureau of Land Management, Denver, CO. Tech. Note TN-250. 25 pp.

Appendix A - Potential habitat for burrowing owls within the Milk River Basin


Legend
Towns
Highways
Major Rivers
Lakes or Reservoirs
Habitat Suitability Index
Highly Suitable (0.76 - 1.0)
Suitable (0.51 - 0.75)
Less Suitable (0.26 - 0.50)
Least Suitable (0 - 0.25)
Warner
Milk River
Coutts
Del Bonita
Onefour
Wild Horse
10 5 0 10 20 30 Kilometres
Scale = 1:550,000
Alberta

Appendix A - Potential habitat for burrowing owls within the Milk River Basin

Legend
Warner
Milk River
Onefour
Del Bonita
Coutts
Wild Horse
Alberta

FERRUGINOUS HAWK (*Buteo regalis*)

Brad N. Taylor
Alberta Conservation Association, Lethbridge, AB

1.0 PURPOSE AND LIMITATIONS

The purpose of this model is to indicate potential habitat for ferruginous hawks (*Buteo regalis*) within the Milk River Basin. As this is a landscape level model with coarse variables, it may not be directly applicable to other areas or for site-specific analysis.

2.0 GENERAL INFORMATION

The ferruginous hawk is a large buteo generally associated with prairie habitat (Schmutz 1987). In the United States, it is a common nester in at least six states and uncommon or rare in an additional five (Olendorff *et al.* 1989). In Canada, it breeds in the three prairie provinces (Schmutz 1993) and migrates south to winter. Nest site selection by ferruginous hawks indicates a preference towards trees, man-made structures (nesting poles), or steep slopes (Schmutz 1987). Prolonged disturbance in close proximity to nest sites during the breeding stage can cause nest abandonment (Schmutz 1984, White and Thurow 1985). The current status of the ferruginous hawk in Alberta is "At Risk" and it is designated "Threatened" under Alberta's Wildlife Act (Alberta Sustainable Resource Development 2001).

3.0 HABITAT ASSOCIATIONS

3.1 Food

Although ferruginous hawks have been recorded taking various small mammals and birds as prey (Wakely 1976, Woffinden 1975, Howard 1975, Lokemoen and Deubbert 1976, Schmutz 1977, 1982, 1984, 1987, Fitzner *et al.* 1977), the majority of the biomass obtained is generally linked to one species. Richardson's ground squirrels (*Spermophilus richardsonii*) appear to be the primary prey species for ferruginous hawks in Alberta (Schmutz 1982, 1987). Schmutz (1982, 1987) also demonstrated a strong correlation between ferruginous hawk abundance and a Richardson's ground squirrel index. Good foraging habitat for ferruginous hawks consists of native prairie with low cover values (Wakely 1976) that can sustain ground squirrel populations. Foraging areas are important to ferruginous hawks since they will return to the same area to forage 50% of the time following a successful strike (Wakely 1976).

3.2 Cover

The ferruginous hawk is a grassland or desert-shrub nester (Woffinden and Murphy 1989). Within Alberta, ferruginous hawks are found in all four subregions of the grassland ecoregion, and sporadically in the parkland ecoregion (Schmutz 1982, Stepnisky *et al.* 2001). Uncultivated grassland is a major component of ferruginous hawk habitat (Schmutz 1984, 1987, Lokemoen and Doebbert 1976).

3.3 Nesting Habitat

Ferruginous hawk nesting density has been negatively correlated with the amount of cultivation present (Schmutz 1982, 1987); furthermore, extensive cultivation acts as a barrier to population increase (Schmutz 1987). Schmutz (1982) found that almost all ferruginous hawk nests were located further than 500 m away from active farmyards. Ferruginous hawks will select for elevated nesting structures (i.e. trees or man-made structures); however, in areas devoid of trees, ground nests are generally found on cutbanks of varying steepness (Schmutz 1982) or located on hill tops or high on the hill slope with westerly aspects (Lokemoen and Duebbert 1976). Ferruginous hawks have been observed ground nesting on rock outcrops within the Milk River Basin (R. Quinlan, pers. comm.). In southeastern Montana, most occupied ground nests were situated on slopes between 15 –30% (Ensign 1983).

Ferruginous hawks generally avoid dense tree stands (Smith and Murphy 1973, as cited in Lokemoen and Duebbert 1976). In South Dakota, tree nests were found in lone cottonwood trees or small, open groves and averaged 10.4 ± 2.6 m above ground and were within 1 km of prairie in good condition (Lokemoen and Duebbert 1976). Given these preferences, good breeding habitat would be situated at least 500 m away from disturbance and consist of at least 50% native prairie containing a solitary or small group of trees.

4.0 HABITAT AREA REQUIREMENTS

The average territory size for ferruginous hawks is approximately 2.6 to 7.7 km^2 with a diameter of 1.6 to 4 km (Call 1978, as cited in Jasikoff 1982). Home range diameters for ferruginous hawks averaged 3.2 to 3.4 km, with minimum and maximum diameters of 2.4 km and 4.2 km, respectively (Jasikoff 1982). In Alberta, Schmutz (1977) indicated that ferruginous hawk nesting sites were rarely closer than 800 m from the next nearest ferruginous hawk nest, while in South Dakota, Lokemoen and Duebbert (1976) found the distance to be 2.6 ± 1.0 km between nests. With respect to foraging, eight of nine hunting forays along the Utah-Idaho border were within 800 m of the nest site (Howard and Wolfe 1976).

5.0 ASSOCIATED SPECIES

In Alberta, ferruginous hawks are strongly associated with Richardson's ground squirrels. Other prey species may include the western meadowlark (*Sturnella neglecta*), bullsnakes (*Pituophis catenifer sayi*), and garter snakes (*Thamnophis spp.*). Additional species that may be found in similar habitat include the prairie rattlesnake (*Crotalus viridis viridis*), burrowing owl (*Athene cunicularia*), Swainson's hawk (*Buteo swainsoni*), red-tailed hawk (*Buteo jamaicensis*), golden eagle (*Aquila chrysaetos*), prairie falcon (*Falco mexicanus*), and the American badger (*Taxidea taxus*).

6.0 THE HSI MODEL

6.1 Assumptions

Ferruginous hawks are limited to areas of minimal disturbance and areas that have an adequate forage base.

- Areas of high quality native prairie in the Milk River Basin are currently less disturbed than broken prairie
- Breeding ferruginous hawks will select areas of low disturbance for nesting
- Nesting areas will overlap/be adjacent to foraging areas
- Foraging areas will be suitable for Richardson's ground squirrel, the primary prey species
- Soil texture is a suitable variable for identifying potential ground squirrel habitat

6.2 Selected Habitat Variables

6.2.1 Native Prairie Class (V_1)

Native Prairie Class (NPC) is derived from the Native Prairie Vegetation Baseline Inventory developed by Alberta Environment. Class 1 is comprised of greater than 75% native prairie components (i.e. shrubs, graminoids, riparian areas, lakes, wetlands, and trees), Class 2 is 50 – 75%, Class 3 is 25 – 50%, Class 4 is 1 – 25%, and Class 5 is no native prairie components (Prairie Conservation Forum 2000). Native prairie is probably the most important and limiting factor for ferruginous hawks. Although hawks have been found in areas that were primarily under cultivation (Schmutz 1987, Lokemoen and Duebbert 1976), they were in close proximity to prairie in good condition. Overall NPC was selected over its individual components (i.e. percent graminoids) because it is more indicative of undisturbed prairie and consequently, nesting habitat (Figure 3.1).

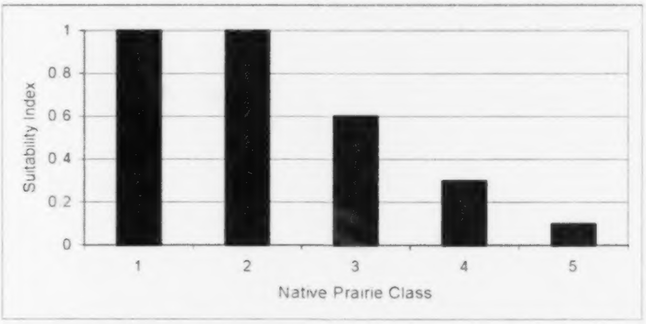


Figure 3.1 Habitat suitability index for native prairie class for the ferruginous hawk

6.2.2 Soil Texture (V_2)

Most burrowing mammals require medium to moderately coarse textured soils (Table 3.1) for burrows. Texture data contained in the Agricultural Region of Alberta Soils Inventory Database (AGRASID) (Alberta Soil Information Centre 2001) was used to provide an indication of potential ground squirrel sites or ferruginous hawk foraging areas (Figure 3.2).

Table 3.1 Soil texture classifications

Soil Texture Classification	Symbol	Soil Textures Included
Coarse	C	Sands, Loamy sands
Moderately Coarse	MC	Sandy loam
Medium	M	Loam, Silt loam, Silt
Moderately Fine	MF	Sandy clay loam, Silty clay loam, Clay loam
Fine	F	Sandy clay, Silty clay, Clay

Footnote 1 U.S. Department of Agriculture Classification System adapted from Brady and Weil (1999)

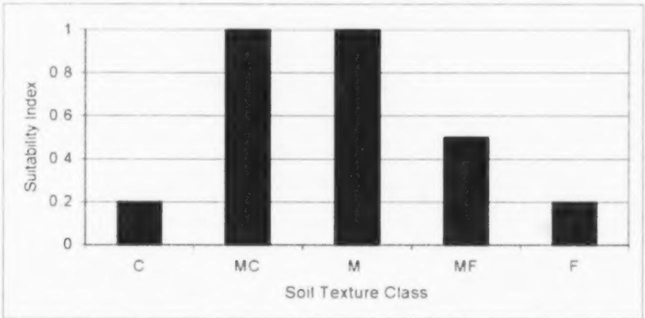


Figure 3.2 Habitat suitability index for soil texture classification for the ferruginous hawk

7.0 HSI EQUATION

$$HSI = V_1 * V_2$$

Both variables are considered equal and non-compensatory (low values of one variable cannot be compensated by a higher value in the other) in defining the quality of breeding habitat for ferruginous hawks within the Milk River Basin. These are relatively broad variables and provide a general indication of potential ferruginous hawk breeding habitat. A more precise habitat suitability model has been developed (Jasikoff 1982); however, habitat information and spatial data layers were not available for use with this model. Analysis of proximal and aerial relationships between spatial data layers was not possible at the time of publication.

7.1 Other Variables Considered

7.1.1 Vegetation

Vegetation height was used in the habitat suitability model developed by Jasikoff (1982) but it is more suitable for site-specific analysis rather than applicable to a landscape level model. Horizontal and vertical structure was also considered to help identify potential nesting and foraging areas, however information was not available on these vegetative characteristics at an adequate spatial scale.

7.1.2 Nesting Structures

Nesting structures (natural or artificial) enhance nesting success and could be useful in identifying potential nesting habitat, however, locations of these structures was not available. Consequently, this variable could not be included in the modeling process.

7.1.3 Slope

Ensign (1983) identified slopes used by ground nesting ferruginous hawks in southeastern Montana; however, Schmutz (1987) suggested a preference for elevated nesting structures by ferruginous hawks in Alberta. Consequently, slope may be compensated by other beneficial habitat features and is not critical in the calculation of potential habitat. Moreover, slope data layers were not available at an adequate scale.

8.0 HABITAT SUITABILITY MAP

Large continuous areas of potential habitat for the ferruginous hawks are identified in the coloured map in Appendix B. Potential habitat is available throughout the Milk River Basin except in the central areas surrounding the towns of Milk River, Warner and Coutts. The amount of highly suitable habitat may be limited further with the addition of a slope, nesting structure, or vegetation habitat variable. However these variables are not available at this time.

9.0 LITERATURE CITED

Alberta Soil Information Centre. 2001. AGRASID30: Agricultural Region of Alberta Soil Inventory Database (Version 3.0). Edited by J. A. Brierley, T. C. Martin, and D. J. Spiess. Agriculture and Agri-Food Canada, Research Branch; Alberta Agriculture, Food and Rural Development, Conservation and Development Branch. Available: http://www1.agric.gov.ab.ca/soils/soils.nsf

Alberta Sustainable Resource Development. 2001. The General Status of Alberta Wild Species 2000. Alberta Sustainable Resource Development, Fish and Wildlife Service, Edmonton, AB. 46 pp. Publ. No. I/023.

Call, M. W. 1978. Nesting habitats and surveying techniques for common western raptors. U.S.D.I. Bur. Land Manage. Tech. Note TN-316. 115 pp.

Ensign, J. T. 1983. Nest site selection, productivity, and food habits of ferruginous hawks in southeastern Montana. M.Sc. thesis, Montana State Univ. 84 pp.

Fitzner, R. E., D. Berry, L. L. Boyd, and C. A. Rieck. 1977. Nesting of ferruginous hawks (*Buteo regalis*) in Washington 1974-1975. Condor 79: 245-249.

Howard, R. P. 1975. Breeding ecology of the ferruginous hawk in northern Utah and southern Idaho. M.Sc. thesis, Utah State Univ., Logan.

Howard, R. P. and M. L. Wolfe. 1976. Range improvement practices and ferruginous hawks. J. Range Manage. 29: 33-37.

Jasikoff, T. M. 1982. Habitat suitability index models: Ferruginous hawk. U.S.D.I. Fish and Wildlife Service. FWS/OBS-82/10.10. 18 pp.

Lokemoen, J. T. and H. F. Duebbert. 1976. Ferruginous hawk nesting ecology and raptor populations in northern South Dakota. Condor 78: 464-470.

Olendorff, R. R., D. D. Bibles, M. T. Dean, J. R. Haugh, and M. N. Kochert. 1989. Raptor Habitat Management under the U.S. Bureau of Land Management and Multiple-use Mandate. Raptor Res. Rep. No. 8. 80 pp.

Prairie Conservation Forum. 2000. Native Prairie Vegetation Baseline Inventory. [Online] http://albertapcf.terraengine.com/classinfo.htm Accessed Dec. 18, 2002.

Schmutz, J. K. 1977. Relationships between three species of the genus *Buteo* (Aves) coexisting in the prairie-parkland ecotone of southeastern Alberta. M.Sc. thesis, Univ. of Alberta, Edmonton, AB. 126 pp.

Schmutz, J. K. 1982. An estimate of ferruginous hawks in Alberta and the relationship between their density and land use. Unpubl. report for the Alberta Environmental Research Trust and the Fish and Wildlife Division of Alberta Energy and Natural Resources, Edmonton, AB. 28 pp.

Schmutz, J. K. 1984. Ferruginous and Swainson's hawk abundance and distribution in relation to land use in southeastern Alberta. J. Wildl. Manage. 48: 1180-1187.

Schmutz, J. K. 1987. An estimate of population size and probable causes of population stability in ferruginous hawks in southeastern Alberta. Unpubl. report for Alberta Division of Fish and Wildlife, Edmonton, AB. 41 pp.

Schmutz, J. K. 1993. Population trends of ferruginous hawks in Alberta, including a synthesis for prairie Canada. Unpubl. report for the Committee on the Recovery of Nationally Endangered Wildlife in Canada (RENEW), Ottawa, ON. 21 pp.

Smith, D. G. and J. R. Murphy. 1973. Breeding ecology of raptors in the eastern Great Basin of Utah. Brigham Young Univ. Scientific Bulletin, Biological Service.18: 1-76.

Stepnisky, D. P., G. L. Erickson, J. Iwaasa, and B. Taylor. 2001. An evaluation of the ferruginous hawk population in Alberta based on recent trend data. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Report No. 52, Edmonton, AB. 16 pp.

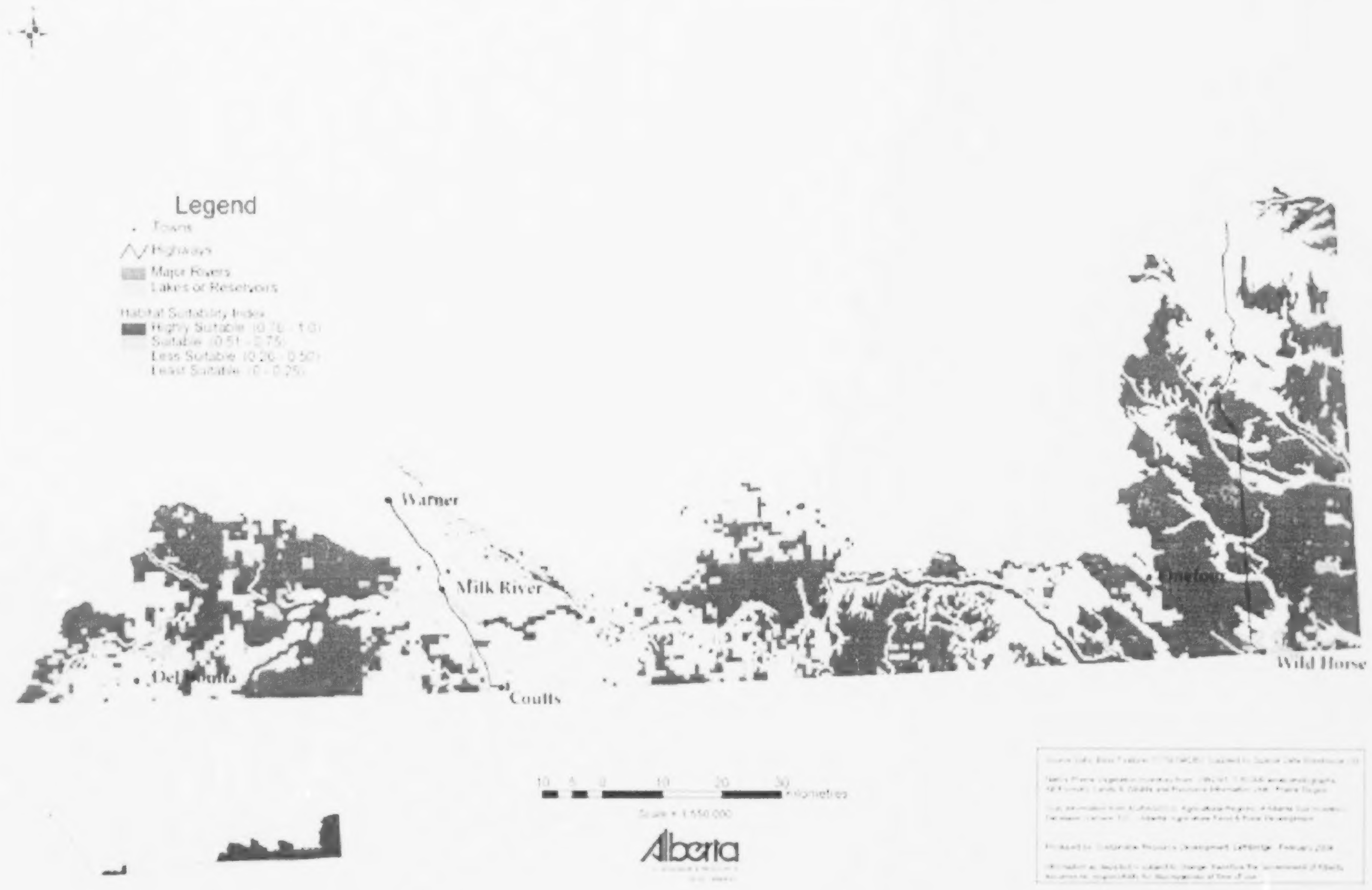
Wakely, J. S. 1976. Food-searching behaviour of free-living ferruginous hawks: factors affecting the use of hunting methods and hunting sites. Ph.D. thesis, Utah State Univ., Logan. 64 pp.

White, C. M., and T. L. Thurow. 1985. Reproduction of ferruginous hawks exposed to controlled disturbance. Condor 87: 14-22.

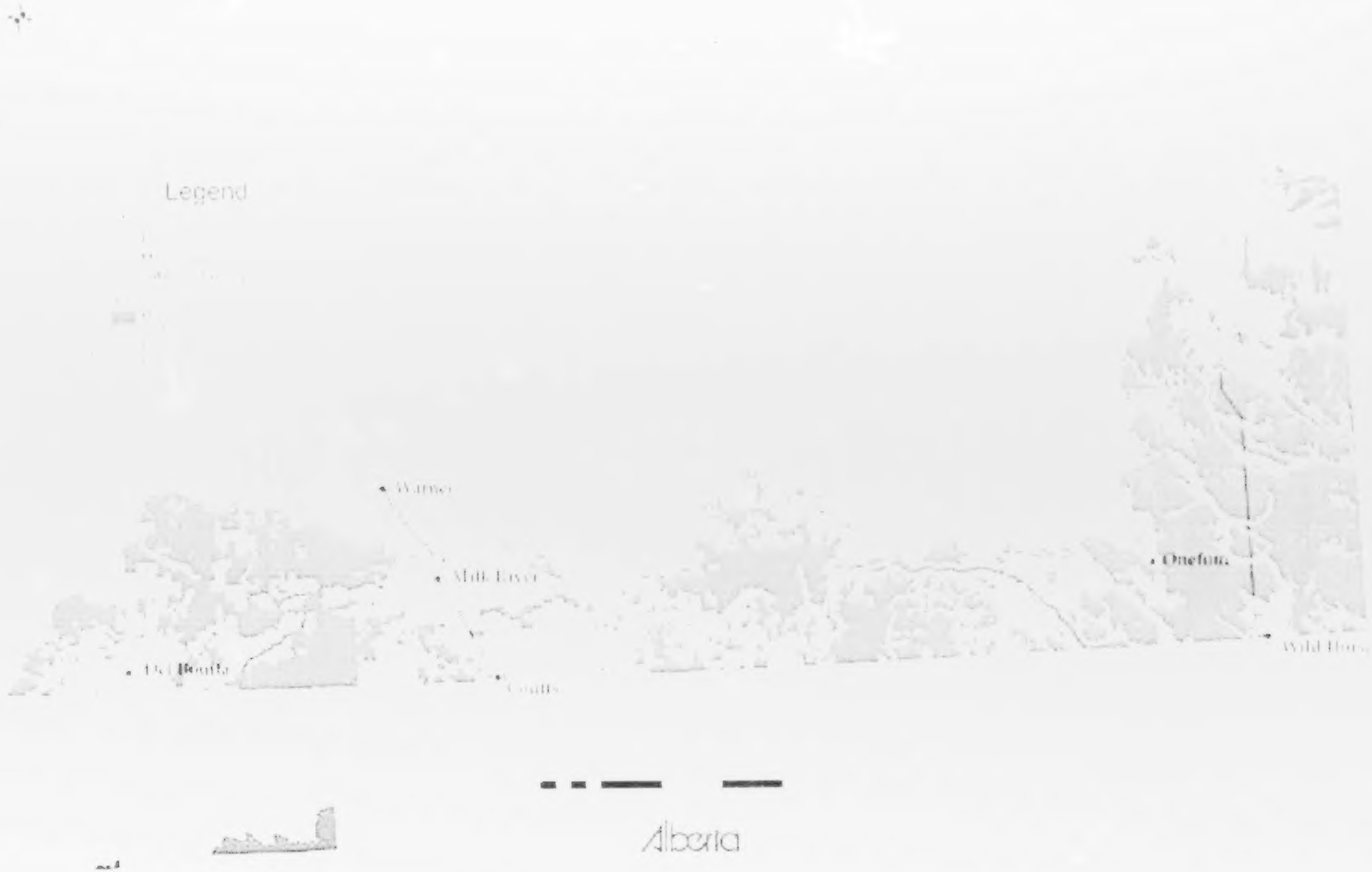
Woffinden, N. D. 1975. Ecology of the ferruginous hawk (*Buteo regalis*) in central Utah: population dynamics and nest site selection. Ph.D. thesis, Brigham Young Univ., Provo, Utah. 102 pp.

Woffinden, N. D. and J. R. Murphy. 1989. Decline of a Ferruginous Hawk population: a 20-year summary. J. Wildl. Manage. 53: 1127-1132.

Appendix B - Potential habitat for ferruginous hawk within the Milk River Basin


Legend
Towns
Highways
Major Rivers
Lakes or Reservoirs
Habitat Suitability Index
Highly Suitable (0.76 - 1.0)
Suitable (0.51 - 0.75)
Less Suitable (0.26 - 0.50)
Least Suitable (0 - 0.25)
Warner
Milk River
Coutts
Del Bonita
Onefour
Wild Horse
10 5 0 10 20 30 Kilometres
Alberta

Appendix B - Potential habitat for ferruginous hawk within the Milk River Basin


Legend
Warner
Milk River
Onefour
Del Bonita
Coutts
Wild Hors

Alberta

LOGGERHEAD SHRIKE *(Lanius ludovicianus excubitorides)*

Brad A. Downey
Alberta Conservation Association, Lethbridge, AB

1.0 PURPOSE AND LIMITATIONS

The purpose of this model is to indicate potential habitat for loggerhead shrike (*Lanius ludovicianus excubitorides)* within the Milk River Basin. As this is a landscape level model with coarse variables, it may not be directly applicable to other areas or for site-specific analysis.

2.0 GENERAL INFORMATION

The loggerhead shrike, also known as the "butcher bird," is a predatory songbird of the grasslands and parklands. Loggerhead shrikes are currently ranked as a "Sensitive" species and a species of "Special Concern" in Alberta (Alberta Sustainable Resource Development 2001). They are listed as "Threatened" in Canada by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC; Johns 1994). The loggerhead shrike's range within Alberta has decreased over the last few decades (Collister 1994), with several studies referring to loss of habitat as a key cause. Loggerheads are slightly smaller than American robins (*Turdus migratorius*) and are identified by their grey body and head, black facemask through their eyes, white belly, and white patches on their black wings (Collister 1996, National Geographic 1999). Males and females look similar in appearance (Prescott and Bjorge 1999), however sex can be determined by the presence of a brood patch on the female's belly (only the female incubates). Nesting in Alberta usually occurs around mid-May, with most shrikes fledged by early July (Collister 1994). Shrikes will also renest nearby if their first nesting attempt fails.

3.0 GENERAL HABITAT ASSOCIATIONS

3.1 Food

Prey includes several invertebrates such as grasshoppers, beetles, and bees along with vertebrates dominated by small mammals, birds, and on rare occasions amphibians and snakes. Shrikes do not have raptorial feet so they impale their prey on barbed wire or plant thorns, which makes them easier to handle. Barbed wire is also used to store food for future consumption when prey may be hard to find (Prescott and Bjorge 1999).

Loggerhead shrikes are visual predators and require hunting perches to effectively forage (Collister 1994). Perching locations such as power lines, barbed wire fences, corrals, snags, and dead branches are ideal for hunting, enabling them to spot and easily swoop down on their prey.

3.2 Cover

Loggerheads prefer open habitat (grassland and agricultural areas) containing scattered clumps of shrubs or hedgerows within close proximity to multiple landscape types such as pastures, meadows, and right of ways (Collister 1996, Bjorge and Prescott 1996, Brooks and Temple 1990). These open habitats are often heavily grazed or mowed (De Smet 1993) with shrikes avoiding tall, dense vegetation (Gawlik and Bildstein 1993), although taller vegetation adjoining heavily grazed native pasture (edge habitat) is favoured for hunting (Prescott and Collister 1993). Shrikes have also been known to use cropland and bare ground for foraging (Prescott and Bjorge 1999).

Shrikes in the Milk River Region of Alberta utilize several species of shrubs and trees. Of all the shrikes found in the Milk River Region by Wershler (1989), 20 % used thorny buffaloberry (*Shepherdia argentea*), 33% willow (*Salix*), 20% common caragana (*Caragana arborescens*), 13% Manitoba maple (*Acer negundo*), 7% Siberian elm (*Ulmus rubra*), and 7% sagebrush (*Artemesia cana*). Loggerhead nests were found in natural shrub communities in valleys, including the Milk River, as well as in exotic shelterbelts and scattered upland sites (Smith 1991). Valleys and exotic shelterbelts accounted for 78% of the sites, with 43% of shrikes being found in cultivated areas and 57% in grassland (Smith 1991). In southeastern Alberta shrikes prefer small clumps of shrubs and hedgerows/shelterbelts for nesting and hunting perches (Collister 1994). Yosef and Grubb, Jr. (1994) confirmed that hunting perches are a limiting factor for shrike habitat.

4.0 HABITAT AREA REQUIREMENTS

The mean territory size for loggerhead shrikes in southeastern Alberta changes from 5.9 ha during incubation to 6.7 ha during the nestling period (Collister 1994). The total mean area covered during breeding was 8.5 ha, with the distance between nests usually 200m (Collister 1994). Collister's (1994) study occurred along a narrow 1 km by 36 km strip of rail line where there was excellent habitat throughout (somewhat atypical for Alberta) and a dense population of shrikes, showing that these birds can tolerate restricted territories.

5.0 ASSOCIATED SPECIES

Badgers *(Taxidea taxus)*, burrowing owls *(Athene cunicularia)*, ferruginous hawks *(Buteo regalis)*, and Richardson's ground squirrels *(Spermophilus richardsonii)* can be found in similar habitat as loggerhead shrikes. Shrikes compete for suitable nesting habitat with Eastern kingbirds *(Tyrannus tyrannus)*, Western kingbirds *(Tyrannus verticalis)*, and Brewer's blackbirds (*Euphagus cyanocephalus)*. Black-billed magpies *(Pica hudsonia)* and Brewer's blackbirds have been known to depredate shrike's nests (De Smet and Conrad 1989 in Johns *et al.* 1993) and kestrels (*Falco sparverius*) and kingbirds have been observed in aggressive interactions with shrikes (Chabot 1994).

6.0 THE HSI MODEL

6.1 Selected Habitat Variables

6.1.1 Shrub Coverage (V_1)

Shrub encroachment increases the availability of perch and nest sites in grasslands, however as shrub density increases, foraging space decreases. Therefore, even though there would be more nesting opportunities for shrikes, the lack of foraging space would decrease the suitability of the site (Figure 4.1) (Telfer 1992). All 29 loggerhead shrikes sites within the Milk River Basin contain 30% or fewer shrubs.

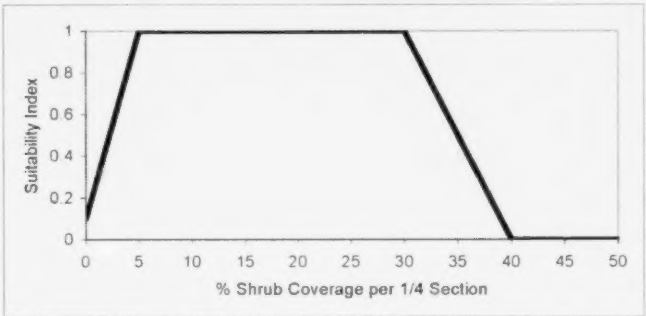


Figure 4.1 Habitat suitability index for shrub coverage for the loggerhead shrike

6.1.2 Graminoid Coverage (V_2)

Collister (1994) found that the average loggerhead shrike territory contained >80% graminoids. Therefore, this was chosen as the threshold and assigned an HSI value of 1 (Figure 4.2). Studies by Brook and Temple (1990) also found that potential shrike habitat increases as herbaceous cover increases.

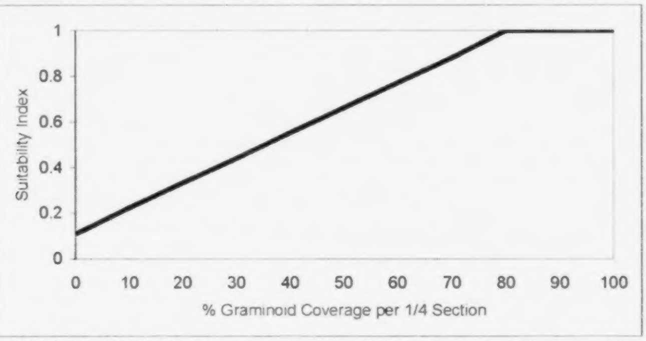


Figure 4.2 Habitat suitability index for graminoid coverage for the loggerhead shrike

6.1.3 Slope (V_3)

Shrikes prefer relatively flat open prairies and parklands, with high horizontal and vertical structural diversity (Dechant 2001) so they can easily spot and catch prey. Therefore, any incline that would decrease the shrike's ability to detect prey is given a lower HSI value (<1)(Figure 4.3). Slopes categories were selected after reviewing the coarse data layer available for mapping. Slopes between 0-25 are considered acceptable for shrike habitat. These numbers were based on the coarse nature of the data layer used, other regions may have different slope numbers depending on how refine their slope data layer is.

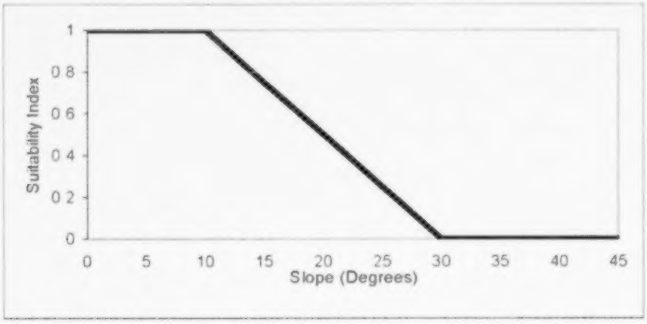


Figure 4.3 Habitat suitability index for slope for the loggerhead shrike

7.1.1 Island Habitat

Farmyards within a sea of cultivation can act as island refuges for shrikes and other shrub nesting birds (Figure 4.4). Most farmyards provide edge habitat, consisting of grassland and cultivation separated by hedgerows.

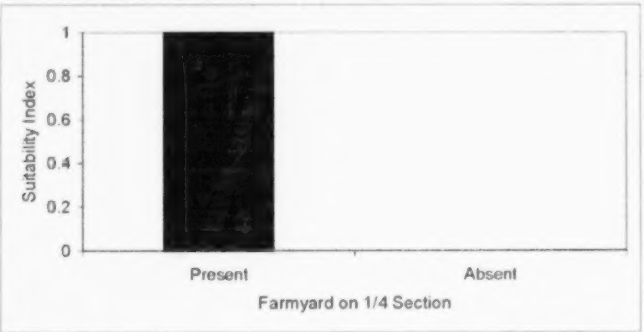


Figure 4.4 Habitat suitability index for farmyards for the loggerhead shrike

7.0 HSI EQUATION

$$\mathbf{HSI = (V_1 * V_2 * V_3)^{1/3} + (.25 * V_4)}$$

Shrubs (V_1), graminoids (V_2), and slope (V_3) are compensatory, with lower values of one variable being improved by another. The formula, however, can also be non-compensatory in cases where one of the first three variables receives a 0 value. In those cases, the 0 value negates the values of the other two variables. For this study, the ¼ sections containing at least 80% graminoids and 5% shrubs on flat terrain would be ideal loggerhead shrike habitat. Conversely, as slope and percent shrub cover increases the habitat suitability of the site decreases. Farmyards (V_4) increase the HSI values of poorer quality sites due to an increased probability of shrubs and edge habitat existing there.

7.1 Other Variables Considered

7.1.1 Grass Heights

There was no available database containing information on grass heights. This variable would have been useful in identifying areas of tall vegetation adjacent to short vegetation; transition zones favoured by shrikes for hunting.

7.1.2 Shrub Complexes

Being able to identify whether there are several single shrubs scattered throughout a ¼ section, a few hedgerows, or a dense clump of shrubs/trees would allow more precise modelling of loggerhead shrike habitat. The highest HSI values would have been assigned to ¼ sections containing small scattered clumps of shrubs or hedgerows/ shelterbelts, the preferred habitat for shrikes in southeastern Alberta for nesting and hunting (Collister 1994). Unfortunately, this data layer does not exist for the Milk River Basin.

7.1.3 Riparian Areas

Shrikes are primarily birds of the flat prairie and parkland regions; however, small riparian zones may be beneficial by providing them with nesting sites, especially in the dry regions of the Milk River Basin. For these riparian zones to be valuable they would have to contain large flat valleys with shrubs (e.g. Lost River in southeastern Alberta). Unfortunately, the data layer could not differentiate between small narrow valleys and larger wider valleys, so it was not practical to include this variable.

8.0 FUTURE MANAGEMENT/RECOMMENDATIONS

Increasing suitable loggerhead shrike habitat can be achieved through a variety of means:

1) The addition of at least one patch of thorny buffaloberry or willow per ¼ section in suitable locations can improve habitat (Telfer 1992).

2) Land management practices that promote heterogeneous herbaceous vegetation heights rather than intensive grazing.

9.0 HABITAT SUITABILITY MAP

Please refer to Appendix C for a colour map which indicates areas where there is potential for shrikes to occur within the Milk River Basin, based on the four selected habitat variables (graminoids, slope, shrubs, and farmyards). The amount of highly suitable habitat has been refined from the 2003 preliminary model (Downey 2003) by replacing the wetland variable with a farmyard variable.

10.0 LITERATURE CITED

Alberta Sustainable Resource Development. 2001. The General Status of Alberta Wild Species 2000. Alberta Sustainable Resource Development, Fish and Wildlife Service, Edmonton, AB. 46 pp. Publ. No. I/023.

Bjorge, R.R., and D.R.C. Prescott. 1996. Population estimate and habitat associations of the Loggerhead Shrike, *Lanius ludovicianus*, in southeastern Alberta. Canadian Field-Naturalist 110(3): 445-449.

Brooks, B.L., and S.A. Temple. 1990. Habitat availability and suitability for loggerhead shrikes in the upper Midwest. American Midland Naturalist 123: 75-83.

Chabot, A.A. 1994. Habitat selection and reproduction biology of the loggerhead shrike in Eastern Ontario and Quebec. Unpublished M. Sc. thesis. Macdonald Campus of McGill University. Montreal, Quebec. 161 pp.

Collister, D.M. 1994. Breeding ecology and habitat preservation of the Loggerhead Shrike (*Lanius ludovicianus*) in southeastern Alberta. Unpublished M.Sc. thesis. University of Calgary, Calgary Alberta. 161 pp.

Collister, D.M. 1996. 1996 Population survey of loggerhead shrike, *Lanius ludovicianus excubitorides*, nesting pairs Bassano subdivision- Atlee to Cavendish. Unpublished Report. Alberta Environmental Protection, Edmonton, AB. 9 pp.

De Smet, K.D. 1993. Status of ferruginous hawk and loggerhead shrike recovery efforts. Pp. 329-332 IN: Proceedings of the third prairie conservation and endangered species workshop. Edited by G.L. Holroyd, H.L. Dickson, M. Regnier, and H.C. Smith. Provincial Museum of Alberta Natural History Occasional Paper 19: 1-384.

De Smet, K.D., and M.D. Conrad. 1989. The Loggerhead Shrike in Manitoba, its status and habitat needs. Unpublished report, Manitoba Department of Natural Resources, Winnipeg, MB. 23 pp. + app.

Downey, B.A. 2003. Loggerhead Shrike. Pages 136-144 in Quinlan, R.W., B.A. Downey, B.N. Taylor, P.F. Jones, and T.B. Clayton (eds.). A multi-species conservation strategy for species at risk in the Milk River basin: year 1 progress report. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Report No. 72, Edmonton, Alberta.

Gawlik, D.E., and K.L. Bildstein. 1993. Seasonal habitat use and abundance of loggerhead shrikes in South Carolina. Journal of Wildlife Management 57 (2): 352-357.

Johns, B., E. Telfer, M. Cadman, D. Bird, R. Bjorge, K. De Smet, W. Harris, D. Hjertaas, P. Laporte, and R. Pittaway 1994. National Recovery Plan for the Loggerhead Shrike, Report No. 7. Ottawa: Recovery of Nationally Endangered Wildlife Committee. 32 pp.

National Geographic.1999. Field Guide to the Birds of North America-Third edition. National Geographic Society. Washington, D.C. 480 pp.

Prairie Conservation Forum. 2000. Native Prairie Vegetation Baseline Inventory. [Online] http://albertapcf.terraengine.com/classinfo.htm Accessed Dec. 18, 2002.

Prescott, D.R.C., and D.M. Collister. 1993. Characteristics of occupied and unoccupied Loggerhead Shrike territories in southeastern Alberta. Journal of Wildlife Management 57: 346-352.

Prescott, D.R.C., and R.R. Bjorge. 1999. Status of the Loggerhead Shrike (*Lanius ludovicianus*) in Alberta. Alberta Environment, Fisheries and Wildlife Management Division, and Alberta Conservation Association, Wildlife Status Report No. 24, Edmonton, AB. 28 pp.

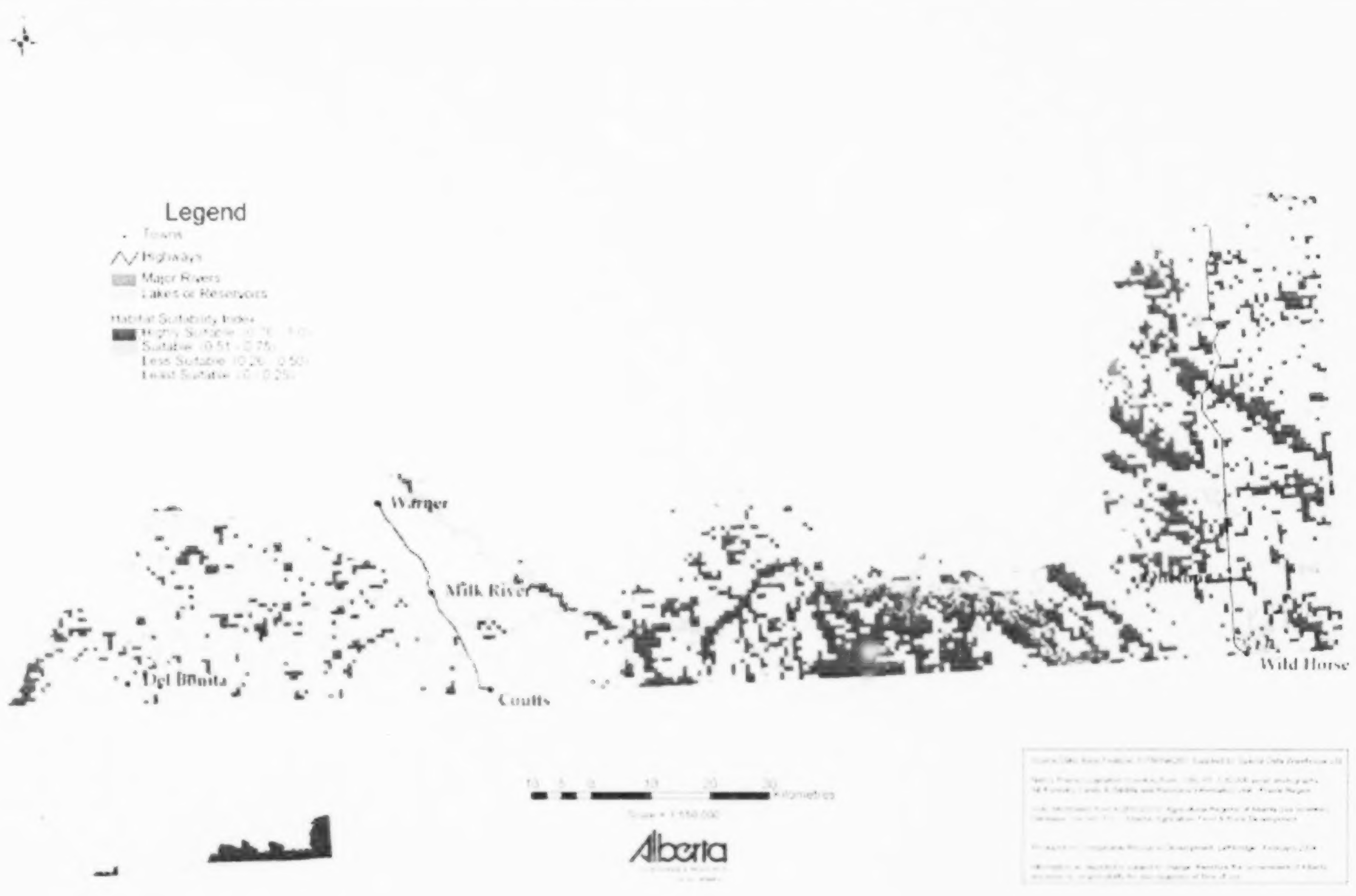
Smith, W.W. 1991. The loggerhead shrike in Alberta. Pp. 241-242 IN: Proceedings of the second prairie conservation and endangered species workshop. Edited by G.L. Holroyd, G. Burns, and H. C. Smith. Provincial Museum of Alberta Natural History Occasional Paper 15: 241-242.

Telfer, E.S. 1992. Habitat change as a factor in the decline of the western Canadian Loggerhead Shrike, *Lanius ludovicianus*, population. Canadian Field-Naturalist 106 (3): 321-326.

Wershler, R.M. 1989. Nesting habitat and abundance of the Loggerhead Shrike (*Lanius ludovicianus*) in two key areas of southern Alberta. Unpublished report for World Wildlife Fund Canada and Alberta Fish and Wildlife. 27 pp.

Yosef, R., and T.C. Grubb, Jr. 1994. Resource dependence and territory size in loggerhead shrikes (*Lanius ludovicianus*). The Auk 111 (2): 465-469.

Appendix C - Potential habitat for loggerhead shrike within the Milk River Basin


Legend
Towns
Highways
Major Rivers
Lakes or Reservoirs
Habitat Suitability Index
Highly Suitable (0.76 - 1.0)
Suitable (0.51 - 0.75)
Less Suitable (0.26 - 0.50)
Least Suitable (0 - 0.25)
Warner
Milk River
Coutts
Del Bonita
Wild Horse
10 5 0 10 20 30 Kilometres
Alberta

LONG-BILLED CURLEW *(Numenius americanus)*

Brandy L. Downey
Alberta Fish and Wildlife, Lethbridge, AB

1.0 PURPOSE AND LIMITATIONS

The purpose of this model is to indicate potential nesting and foraging habitat for the long-billed curlew (*Numenius americanus*) within the Milk River Basin. As this is a landscape level model with coarse variables, it may not be directly applicable to other areas or for site-specific analysis.

2.0 GENERAL INFORMATION

The long-billed curlew (*Numenius americanus*) is the largest member of the sandpiper family (Saunders 2001). It is distinguishable by its long downward curved bill, large size and cinnamon brown colouring. The long-billed curlew is long-lived with low productivity, which leads them to be sensitive to environmental changes (Hill 1998). Their range has decreased rapidly over the last few decades, and it is presently considered a "May Be at Risk" species in Alberta, (General status of Alberta species 2001), and a "Species of Special Concern" in Canada (COSEWIC 2003).

3.0 GENERAL HABITAT ASSOCIATIONS

3.1 Cover

The long-billed curlew is found throughout the prairie region and into parts of the parkland region of Canada (DeSmet 1992). Though the long-billed curlew is considered to be adaptable in its breeding habitat it is typically located in large undisturbed native pasture (Hill 1998). In Alberta, it tends to use gently rolling, moderately grazed short grass, and fescue prairie (Dechant et al. 2001, DeSmet 1992).

Long-billed curlews have a tendency to avoid areas of high disturbance such as farmyards and agriculture land (Hill 1998). They can be found to nest in cultivated areas, however this tends to occur at a significantly lower rate than native prairie nesting. Although cultivated areas are not generally used for nesting, agriculture lands are utilized by the long-billed curlew for foraging (DeSmet 1992).

3.2 Food

The long-billed curlew frequently preys on grasshoppers and Carabid beetles (DeSmet 1992). They are however an opportunistic feeder and will consume earthworms, small mammals, amphibians and reptiles, as well as eggs and chicks of other birds (Sadler 1976, Timken 1969)

4.0 ASSOCIATED SPECIES

Other species that utilize similar habitat to the long-billed curlew include marbled godwits (*Limosa fedora*), upland sandpipers (*Bartarmia longicauda*), and Sprague's pipit (*Anthus spragueii*) (Hill 1998). Species that prey upon the long-billed curlew and its young include coyotes (*Canis latrans*), American badgers (*Taxidea taxus*), bull snakes (*Pituophis melanoleucus*), black-billed magpie (*Pica pica*), ferruginous hawks (*Buteo regalis*), Swainson's hawks (*Buteo swainsonii*), and great horned owls (*Bubo virginianus*).

5.0 HSI Model

5.1 Assumptions and limitations

Proximity to water tends to be an important factor in nesting habitat throughout much of the long-billed curlew's range, except in Alberta (DeSmet 1992, Dechant et al. 2001). Surveys done in Alberta show that long-billed curlews were less likely to be found near areas of water; this is opposite to findings in other parts of its range (Dechant et al. 2001). Distance from water is not a habitat variable in Alberta and therefore in this model it is assumed that long-billed curlews do not require wetland habitat for nesting.

5.2 Selected Habitat Variables

5.2.1 Native Prairie (V_1)

Historic records and current surveys have shown that long-billed curlews prefer areas of open undisturbed native prairie (Dechant 1992, Saunders 2001). In 2001, Saunders found that long-billed curlews were twice as abundant in the 50-100% native prairie stratum than in stratums containing lower percentages of native prairie. Though long-billed curlews will use areas of cultivation; this occurs after the young have hatched and is typically located in areas adjacent to native pastures (Hill 1998). Therefore agriculture lands, while considered to be undesirable, are still utilized by the long-billed curlew and are included in this model at a lower value than native prairie (Figure 5.1).

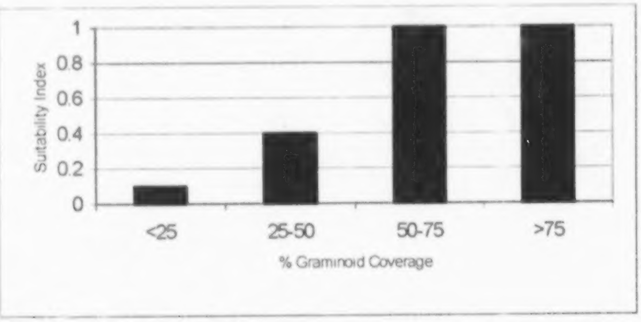


Figure 5.1 Habitat suitability index for graminoid coverage for the long-billed curlew.

5.2.2 Shrub coverage (V_2)

The long-billed curlew requires large open areas for breeding therefore areas of high shrub coverage are not considered suitable habitat (Dechant et al. 2001, DeSmet 1992). However areas with small amounts of shrub coverage can be utilized after the young have hatched, for increased protection. Based on the data available and the overall shrub coverage in the Milk River Basin, areas of greater than 1-10% coverage are considered undesirable for the long-billed curlew (Figure 2).

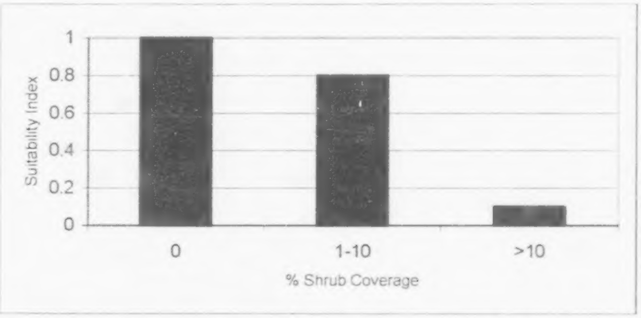


Figure 5.2 Habitat suitability index for percent shrub coverage for the long-billed curlew.

4.2.3 Topography (V_3)

The long-billed curlew is usually found in areas of flat to rolling topography (DeSmet 1992). Areas of steep slopes, such as coulees, are avoided because of lack of nesting habitat as well as high visibility of the birds to predators. Consequently any slope over 25 degrees is considered unsuitable habitat and receives a rating of zero (Figure 5.3). Due to the coarseness of the slope variable for the Milk River Basin 15 degrees is used to determine areas of 15 degrees slope, this may change depending on the refinement of the area being modeled.

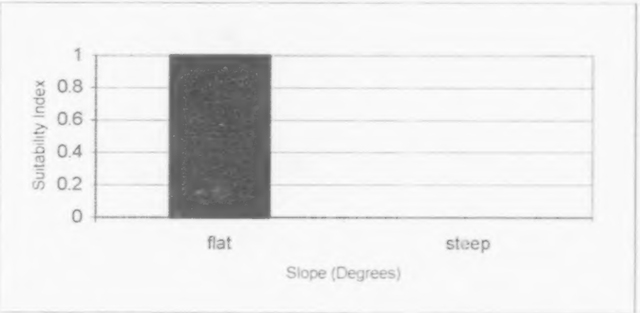


Figure 5.3 Habitat suitability for slope for the long-billed curlew.

5.0 HSI EQUATION

$$HSI=(V_1*V_2*V_3)^{1/3}$$

The three variables included in this model are considered compensatory; a high value of one variable will compensate for a low value of another variable. However a value of zero for one variable will still result in an overall value of zero. The model is based on the assumption that the long-billed curlew utilizes areas of undisturbed, open, flat native prairie for nesting and foraging over other habitat types. While areas of mixed habitat can be utilized it is at a significantly lower rate than native prairie.

6.0 OTHER VARIABLES

The variables that are used in this model depend on the digital data available; variables that are not represented in digital form cannot be included. One such variable is the grazing pressure and grass height in an individual quarter section. Grazing pressure and grass height is important in the habitat selection of the long-billed curlew; in Alberta they tend to utilize moderately grazed grasslands significantly more than other grazing schemes (Dechant et al. 2001). However, due to the ever-changing nature of this variable it is not possible to maintain an accurate digital layer and consequently it is not included.

7.0 HABITAT SUITABILITY MAP

Please refer to Appendix D for a colour map, which indicates areas with potential habitat for the long-billed curlew in the Milk River Basin. Potentially suitable habitat is available throughout the basin. However the central areas of the basin are ranked lower due to the higher rates of cultivation in these areas. This model accurately reflects results from past surveys in the Milk River Basin (Saunders 2001).

8.0 LITERATURE CITED

Alberta Sustainable Resource Development. 2001. The General Status of Alberta Wildlife Species 2000. Alberta Sustainable Resource Development, Fish and Wildlife Service, Edmonton, AB, 46 pp Publ NoI/023.

COSEWIC. 2003. Canadian Species at Risk, May 2003.Committee on the Status of Endangered Wildlife in Canada. 43 pp.

Dechant, J. A., M. L. Sondreal, D. H. Johnson, L. D. Igl, C. M. Goldade, P. A. Rabie, and B. R. Euliss. 2001. Effects of management practices on grassland birds: Long-billed Curlew. Northern Prairie Wildlife Research Center, Jamestown, ND. Jamestown, ND: Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/resource/literatr/grasbird/fplbcu/fplbcu.htm (Version 29FEB2000).

DeSmet, K. 1992. Status Report on the Long-billed curlew in Canada. Department of Natural Resources. Winnipeg, MB. 27 pp.

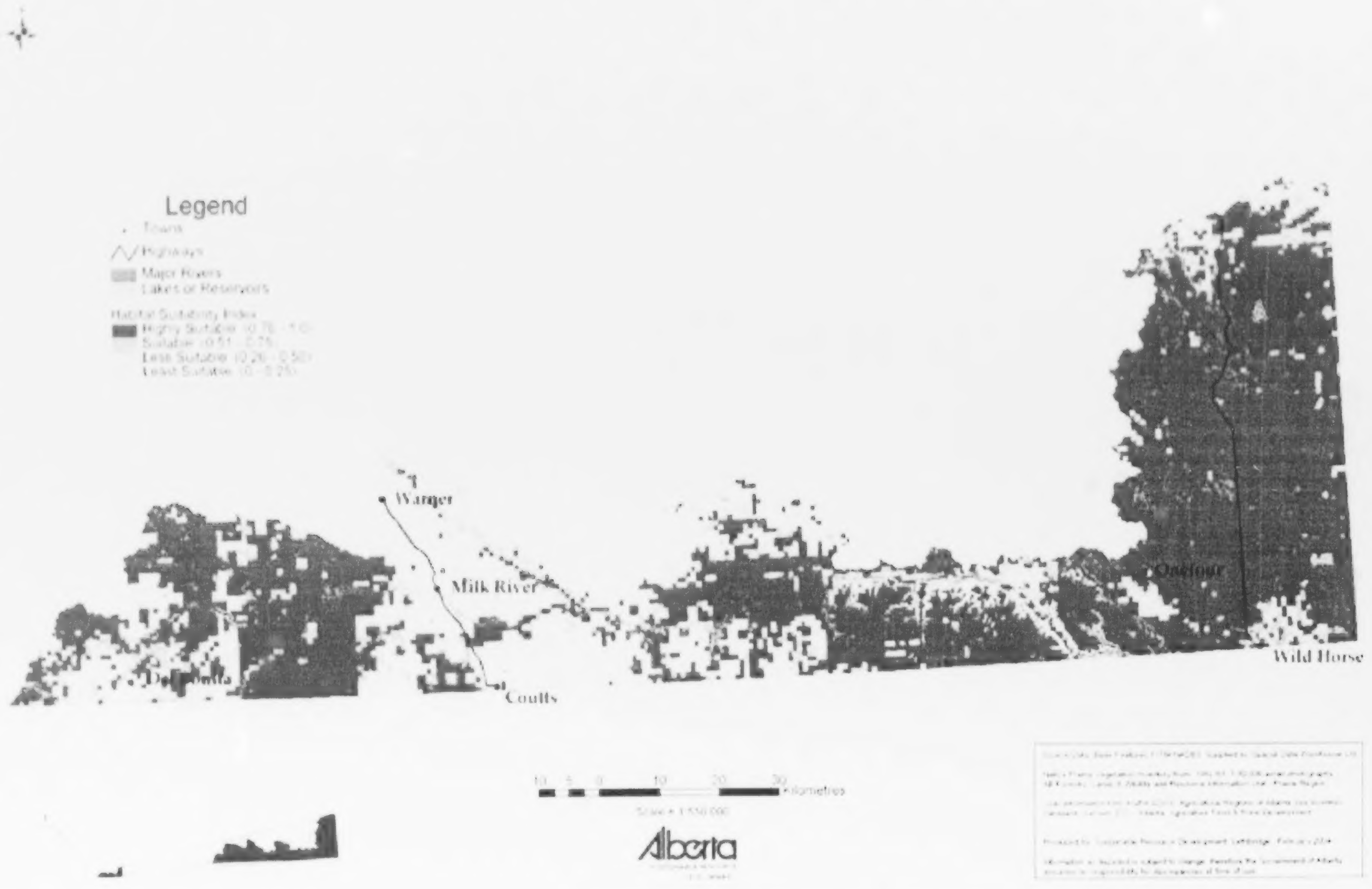
Hill, D.P. 1998. Status of the Long-Billed Curlew(*Numenius americanus*) in Alberta. Alberta Environmental Protection, Fisheries & Wildlife Management Division and Alberta Conservation Association, Wildlife Status Report No. 16, Edmonton, AB. 20 pp

Saunders, Elizabeth J. 2001. Population estimate and habitat associations of the long-billed curlew (*Numenius americanus*) in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife division, Alberta Species at Risk Report No. 25. Edmonton, AB.

Sadler, D.A.R., W.J. Maher. 1976. Notes on the Long-billed curlew in Saskatchewan. Auk 93: 382-84.

Timken, R.L. 1969. Notes on the Long-billed culew. Auk 86: 750-751.

Appendix D - Potential habitat for long-billed curlew within the Milk River Basin


Legend
Towns
Highways
Major Rivers
Lakes or Reservoirs
Habitat Suitability Index
Highly Suitable (0.76 - 1.0)
Suitable (0.51 - 0.75)
Less Suitable (0.26 - 0.50)
Least Suitable (0 - 0.25)
Warner
Milk River
Coutts
Del Bonita
Onefour
Wild Horse
10 5 0 10 20 30 Kilometres
Alberta

PRAIRIE FALCON *(Falco mexicanus)*

Brad A. Downey
Alberta Conservation Association, Lethbridge, AB

1.0 PURPOSE AND LIMITATIONS

The purpose of this model is to indicate potential habitat for prairie falcons (*Falco mexicanus)* within the Milk River Basin. As this is a landscape level model with coarse variables, it may not be directly applicable to other areas or for site-specific analysis.

2.0 GENERAL INFORMATION

Prairie falcons are currently ranked as a "Sensitive" species in Alberta due to the limited availability of nest sites and their reliance on ground squirrel (*Spermophilus spp.*) populations (Paton 2002, Alberta Sustainable Resource Development 2001). They are described as being pale brown in colour from above and creamy white and heavily spotted with brown below. They have a streaked crown and a thin, dark moustache and dark ear coverts with a pale strip between the two (National Geographic 1999). Adult females are larger than the males, and pairs will renest nearby if their first nesting attempt fails.

3.0 GENERAL HABITAT ASSOCIATIONS

3.1 Food

Surveys conducted by Marzluff *et al.* (1997) found prairie falcons to arrive and depart from nesting areas coinciding with the emergence and immergence of Townsend's ground squirrels (*Spermophilus townsendii*). They also found that ground squirrels were, and still are, the most important prey species for prairie falcons within their study area. Suitable ground squirrel habitat in native prairie was found within 5 - 20 km from falcon nests. In Alberta, Hunt (1993) found that use of ground squirrel habitat within 15 km of nest sites was higher than expected, and that ground squirrels accounted for 89% of the biomass used to feed prairie falcon young.

3.2 Cover

Prairie falcons prefer the dry environment of southern Alberta and can be found along the river valleys and tributaries, and in coulees containing steep cliffs and rock outcroppings (Semenchuck 1992). Hunt (1993) found nest sites were frequently associated with flowing rivers or large water bodies where prairie falcons could use the nearby uplands to hunt. Other key habitat characteristics are native prairies and pastures adjacent to river valleys containing ground squirrel colonies. Large-scale conversion of native pasture to cropland can be detrimental to the falcons by limiting the abundance of prey near the nest (Smith *et al.* 1985). Conversely, areas containing small amounts of cropland dispersed within large areas of grassland might be beneficial to prairie falcons in drought years by providing them with the only breeding ground squirrels in the area (Smith *et al.* 1985). Ideal foraging habitat must contain at least 20 % herbaceous vegetation with few shrubs or trees (Sousa 1981). Other components to consider for prairie falcon habitat include perch sites for hunting, and ledges with a cliff overhang to protect them and their young from adverse conditions. If all of these habitat conditions are met and there is available prey due to a mild winter, prairie falcons can overwinter in Alberta (Paton 2002).

4.0 HABITAT AREA REQUIREMENTS

Prairie falcon's home range varies throughout North America and appears to be dependent on the location of ground squirrel colonies. In Idaho, prairie falcons can have home ranges up to 300 km² and still successfully raise young, but any home ranges greater than 300 km² reduced the ability of the parents to effectively feed and protect their young (Marzluff *et al.* 1997). Hunt (1993) found home range size along the Bow River to vary between 31 km² and 192 km², with an average of 72 km². Again, this was dependent on key native grassland sites containing ground squirrels. The most common hunting distance from the nest was 6 km (Hunt 1993, Marzluff *et al.* 1997, Young *et al.*1986)

5.0 ASSOCIATED SPECIES

Cliffs and outcroppings along river valleys can also be used by golden eagles *(Aquila chrysaetos)*, various bat species (*Myotis spp.*), ferruginous hawks *(Buteo regalis)*, red-tailed hawks *(Buteo jamaicensis)*, and peregrine falcons *(Falco peregrinus)*. Upland hunting sites contain Richardson's ground squirrels *(Spermophilus richardsonii)*, which in turn may attract burrowing owls *(Athene cunicularia)* and American badgers *(Taxidea taxus)*.

6.0 THE HSI MODEL

6.1 Selected Habitat Variables

Prairie falcons nest on cliffs along rivers adjacent to grassland (Usher et al. 1998). During a survey conducted for the Milk River Dam, all nest sites were found on steep sloping cliffs (Young et al. 1986). Due to the coarse nature of this variable, 30 degrees and greater were most representative of steep slopes within the Milk River Basin (Figure 6.1). Slope will vary within other regions depending on the refinement of the data layer.

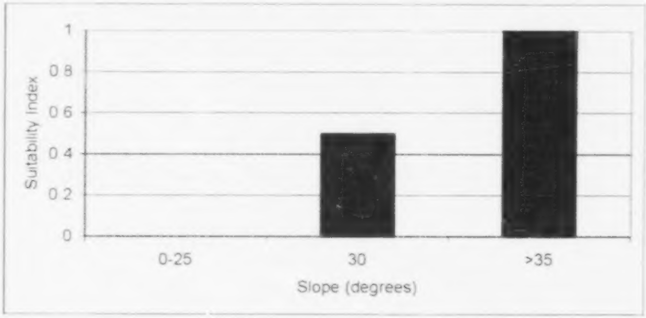


Figure 6.1 Habitat suitability index for slope for the prairie falcon

6.1.2 Richardson's Ground Squirrel HSI Value per Quarter Section (V_2)

Because prairie falcons rely on ground squirrels as their primary food source, the final HSI value from the formula used to map their potential habitat was chosen as V_2 (refer to the Richardson's ground squirrel HSI equation, Chapter 9).

6.1.3 Distance From Ground Squirrel Habitat (V_3)

Marzluff *et al.* (1997) found prairie falcons that hunted >15km away from the nest failed to provide adequate food and care to their young. He suggested that enough prey had to be found within 15km of the nest to support a nesting pair (Figure 6.2). Other studies in southern Alberta found prairie falcons to hunt within 6.2 km of their nest (Young *et al.* 1986, Hunt 1993).

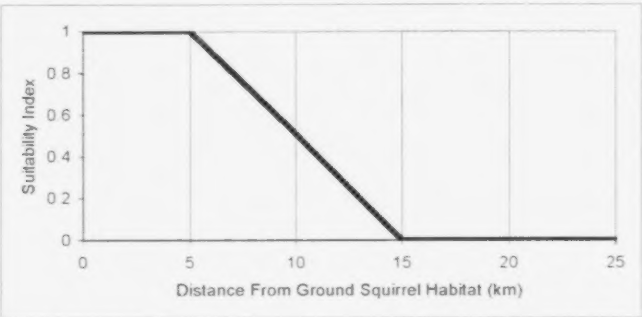


Figure 6.2 Habitat suitability index for forage for the prairie falcon

7.0 HSI EQUATION

$$HSI = Max(V_1, V_2)*V_3$$

Slope (V_1) is a key factor in determining suitable prairie falcon nesting habitat so slopes >10 degrees will always receive an HSI value of one. Foraging habitat around the nest site is also critical, so quarter sections receive values depending on their suitability for ground squirrels (V_2) and the distance these quarter sections are from potential prairie falcon nest sites (V_3). The formula is non-compensatory so that one variable can negatively affect the other, causing the HSI value of the quarter section to be lowered.

8.0 HABITAT SUITABILITY MAP

Please refer to the Appendix E colour map, which depicts potential habitat for prairie falcons within the Milk River Basin. The highlighted areas incorporate both nesting (cliffs) and foraging areas (ground squirrel habitat) within a define distance from nest sites. Large areas are ranked as "least suitable" for the prairie falcon due to a lack of suitable nesting sites or less suitable habitat for ground squirrels (cultivation).

9.0 LITERATURE CITED

Alberta Sustainable Resource Development. 2001. The General Status of Alberta Wild Species 2000. Alberta Sustainable Resource Development, Fish and Wildlife Service, Edmonton, AB. 46 pp. Publ. No. I/023.

Hunt, L.E. 1993. Diet and habitat use of nesting Prairie Falcons (*Falco mexicanus*) in an agricultural landscape in southern Alberta. M.Sc. thesis, University of Alberta, Edmonton, AB. 61pp

Marzluff, J. M., B. A. Kimsey, L.S . Shueck, M. E. McFadzen, M. S. Vekasy, and J. C. Bednarz. 1997. The influence of habitat, prey abundance, sex, and breeding success on the ranging behaviour of Prairie Falcons. Condor 99: 567-584.

National Geographic.1999. Field Guide to the Birds of North America-Third edition. National Geographic Society. Washington, D.C. 480 pp.

Paton, D. 2002. Status of the Prairie Falcon *(Falco mexicanus)* in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division, and Alberta Conservation Association, Wildlife Status Report No. 42, Edmonton, AB. 28 pp.

Semenchuck, G. P. 1992. The Atlas of Breeding Birds of Alberta. The Alberta Federation of Naturalists. Edmonton, AB. 391 pp.

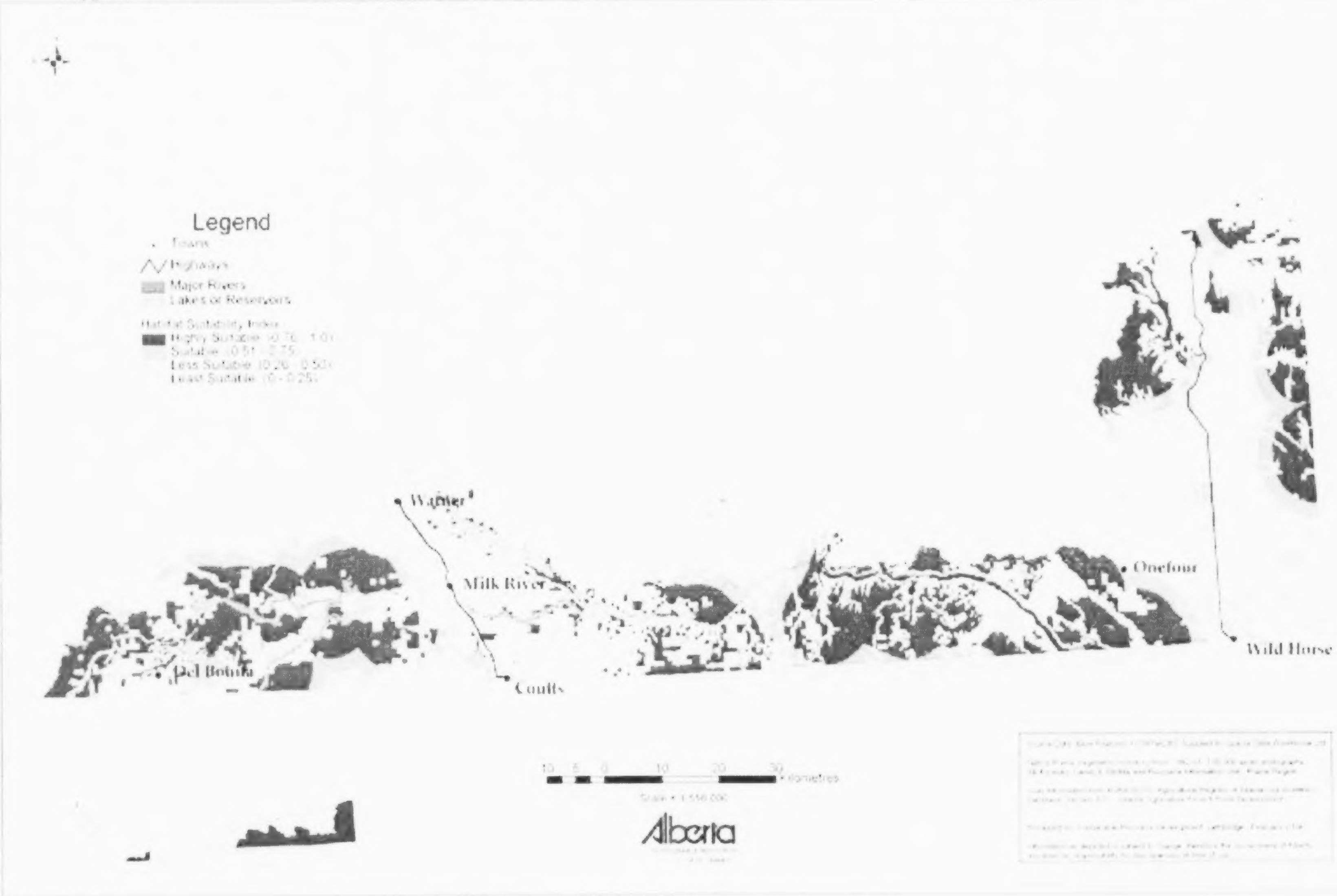
Smith, G. W. and D. R. Johnson. 1985. Demography of a Townsend ground squirrel population in south-western Idaho. Ecology 66: 171-178

Sousa, P. 1981. Prairie Falcon: habitat suitability index model for the Price River- Book Cliffs study areas. Western energy and land use team. U.S. Dept. Inter. Fish and Wildlife Service. Washington, D. C. 13 pp.

Usher,R. G., J. A. Dechka, and G. L. Holroyd. Assessment of Critical Prairie Falcon Foraging Habitat in Southern Alberta Using Satellite Imagery and GIS Technology. Canadian Wildlife Service Report. Edmonton, AB. 4 pp.

Young, D. A., K. Wilkinson, D. S. Kerr, and C. P. Bjornson. 1986. Milk river dam rare flora and fauna investigations during spring and summer 1986- Draft. Alberta Environment, Planning Division. Edmonton, AB.

Appendix E - Potential habitat for prairie falcon within the Milk River Basin


Legend
Towns
Highways
Major Rivers
Lakes or Reservoirs
Habitat Suitability Index
Highly Suitable (0.76 - 1.0)
Suitable (0.51 - 0.75)
Less Suitable (0.26 - 0.50)
Least Suitable (0 - 0.25)
Warner
Milk River
Coutts
Del Bonita
Onefour
Wild Horse
10 5 0 10 20 30 Kilometres
Scale 1:550,000
Alberta

SHARP-TAILED GROUSE *(Tympanuchus phasianellus)*

Paul F. Jones
Alberta Conservation Association, Lethbridge, AB

1.0 PURPOSE AND LIMITATIONS

The purpose of this model is to indicate potential habitat for sharp-tailed grouse (*Tympanuchus phasianellus*) within the Milk River Basin. As this is a landscape level model with coarse variables, it may not be directly applicable to other areas or for site-specific analysis.

2.0 GENERAL INFORMATION

Sharp-tailed grouse are a common upland game bird found throughout Alberta, though higher numbers are concentrated in the grassland, aspen parkland, and Peace River parkland areas. The subspecies plains sharp-tailed grouse (*Tympanuchus phasianellus jamesi*), considered the most prevalent of the six subspecies (Hamerstrom and Hamerstrom 1961, Johnsgard 1973), is found within the Milk River drainage. Though considered the most prevalent subspecies, populations of sharp-tailed grouse have been decreasing in southern Alberta as a result of agricultural practices (Moyles 1981, Goddard 1995).

3.0 GENERAL HABITAT ASSOCIATIONS

Native grass and shrubs are critical habitat components for maintaining viable sharp-tailed grouse populations (Pepper 1972, Hillman and Jackson 1973). Swenson (1985) described optimum habitat in Montana as a mosaic of upland grassland with sumac and riparian hardwood draws. In South Dakota, lightly grazed mixed-grass prairie with occasional shrubby draws is considered optimal habitat (Hillman and Jackson 1973). Moyles (1981) stated that optimal habitat in the central parkland of Alberta consisted of grassland and grassland-shrub mixtures. During certain times of the year and for different life stages, particular habitat types are chosen.

3.1 Cover

3.1.1 Nesting Cover

Sharp-tailed grouse tend to nest within 1.6km of a lek, with the average being 900m (Pepper 1972). For the Milk River Ridge area, Roersma (2001) found the average distance to the nest from the lek was 1.1km. Lush, dense residual cover associated with shrub cover, particularly buckbrush (*Symphoricarpos occidentalis*) and rose (*Rosa* spp.), are considered prime nesting habitat for sharp-tailed grouse (Pepper 1972). Sharp-tails will nest in tame pasture, hay fields, and cultivated stubble but not in treed bluffs or groves (Pepper 1972). They also tend to avoid areas where the vegetation is taller than 6m and are rarely found in areas where the dominant vegetation is less than 24.5cm

(Christenson 1970, Pepper 1972). Roersma (2001) determined that sharp-tailed grouse nests on the Milk River Ridge contained more woody (shrub) cover and less grass cover than random plots, and that heights of all vegetative components tended to be higher at nest sites (Roersma 2001). Nesting habitat characteristics tend to be related to vegetation height and density and not particular species (Pepper 1972, Hillman and Jackson 1973, Prose 1987).

3.1.2 Brood Rearing Habitat

With the young being precocial, sharp-tailed grouse hens leave the nest shortly after hatching in search of brood rearing habitat. Brood rearing habitat consists of shrubs and trees for hiding cover and grassland areas for foraging (Evans 1968, Johnsgard 1973). Shrub cover tends to be selected over treed areas because of its additive value as forage (berries and buds) (Roersma 2001). In Wisconsin, Hamerstrom (1963) reported croplands; weedy fields, meadows and savannahs as open cover brood habitats. Moyles (1981) reported hens in the parkland area of Alberta utilized grassland and grassland- low shrub transition zones for rearing broods. Roersma (2001) determined that brood rearing sites had greater grass cover and reduced litter cover than random sites. The brood sites also had taller vegetation and greater horizontal cover values than random sites (Roersma 2001).

4.0 SPECIAL HABITAT ASSOCIATIONS

4.1 Dancing Grounds

During the spring mating period, male sharp-tailed grouse congregate on leks, or dancing grounds (Johnsgard 1975). On average, 8 to 12 males display on a lek (Ammann 1957, Johnsgard 1975). In 2002, on the Milk River Ridge in southern Alberta, there was an average of 9.4 males per lek for the 27 leks monitored. Resident males establish territories that are adjacent to each other and are approximately 1.8m – 2.7m across (Pepper 1972). Males defend their territories and attract females through acoustic displays (Bergerud and Gratson 1988). Central males tend to be dominant and perform most of the copulation. Most mating occurs in the early morning, with females then leaving the lek to establish a nest (Johnsgard 1975). Habitat characteristics vary for individual dancing grounds but can be generalized as having low, sparse vegetation allowing for good line of sight and unrestricted movement (Johnsgard 1973). They tend to be located on high knolls and ridge tops. Tame pasture, stubble, hayfields, and bogs are used for leks (Ammann 1957).

5.0 HABITAT AREA REQUIREMENTS

It is generally believed that the lek is the focal area for sharp-tailed grouse. Management for prairie grouse has centered on a set area around the lek, termed the breeding complex (Giesen and Connelly 1993). The breeding complex is the area around a lek that encompasses the majority of nesting sites. A breeding complex with a radius of 2 km, resulting in an area of 13 km^2 (1,260 ha), has been suggested for Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*) (Giesen and Connelly 1993, Roersma 2001). For the Milk River Ridge, Roersma (2001) introduced the term total nesting area, which was the area encompassing all nests associated with a dancing ground. The average total nesting area for 5 dancing grounds was 148.1 ha (range 18.6 to 292.5 ha).

Marks and Marks (1987) reported the home range size for Columbian sharp-tailed grouse in Idaho as 190 ha while Giesen (1997) reported the home range size for Columbian sharp-tailed grouse in Colorado as 110 ha. Based on spring and summer locations, Roersma (2001) documented a home range size of 69 ha for sharp-tailed grouse in the Milk River Ridge.

6.0 ASSOCIATED SPECIES

Some of the species associated with sharp-tailed grouse include: the mallard (*Anas platyrhynchos*), American wigeon (*Anas americana*), Gadwall (*Anas strepera*), Northern pintail (*Anas acuta*), Northern shoveler (*Anas clypeata*), Wilson's phalarope (*Phalaropus tricolor*), Upland sandpiper (*Bartramia longicauda*), Long-billed curlew (*Numenius americanus*), Marbled godwit (*Limosa fedoa*), Bobolink (*Dolichonyx oryzivorus*), Sage grouse (*Centrocercus urophasianus*), and songbird and sparrow spp.

7.0 THE HSI MODEL

The resolution of the Native Prairie Vegetation Inventory (NPVI) database did not allow for the modeling of specific habitat characteristics required for different life stages of the sharp-tailed grouse. For example, the quarter section resolution was not adequate for modeling nesting habitat, where height and condition of the range were required. Therefore, the HSI model developed for sharp-tailed grouse is a general habitat model, based on the analysis of lek characteristics (using the NPVI database) (Appendix N) and the work completed by Roersma (2001) for the Milk River Ridge. This model should suffice at the scale of the available data, as leks are the centers of activity.

7.1 Selected Habitat Variables

The HSI model for sharp-tailed grouse is comprised of two habitat variables to describe general habitat needs. They are native prairie cover class (V_1) and percent shrub cover (V_2), and are assumed to represent hiding, nesting, brood rearing, and winter habitat.

7.1.1 Native Prairie Cover (V_1)

Figure 8.1 depicts the HSI relationship for the native prairie cover class. A decrease in HSI value occurs as the cover class increases or the percent class for the quarter section comprised of native vegetation decreases. The native prairie cover class #5, which represents 0% native prairie or agricultural land, was given an HSI score of 0. Even though cropland is utilized by sharp-tailed grouse, as the area converted to agricultural land increases, habitat use decreases until it becomes detrimental to sharp-tailed grouse. Within the NPVI database there is no spatial component that relates where agricultural land is within the quarter section, just what percentage of the quarter section is agricultural land. Therefore, we could not evaluate the spatial distribution of the agricultural land. To account for this, the model airs on the side of caution and gives native prairie class #5 a score of 0.

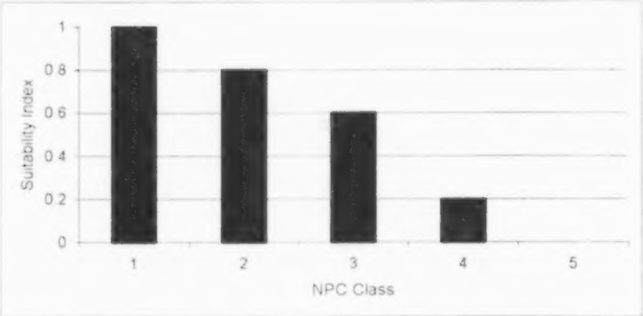


Figure 7.1 Habitat suitability index for native prairie cover class for the sharp-tailed grouse

7.1.2 Percent Shrub Cover

The HSI relationship for shrub cover is shown in Figure 8.2. If no shrub cover is detectable then an HSI score of 0.4 is given. This is based on the assumption that shrub cover is present, just not in a clump that would represent 5% of a quarter section (how it is determined in the NPVI database) and be recorded. An HSI value of 1 is given to the range of 5% to 15% shrub cover (Prose 1987) and then the value decreases until shrub cover reaches $\geq$20% at which point the HSI value is 0. With the model not focusing on any specific life requisite it can be applied across the entire study area and likely the Grassland Natural region.

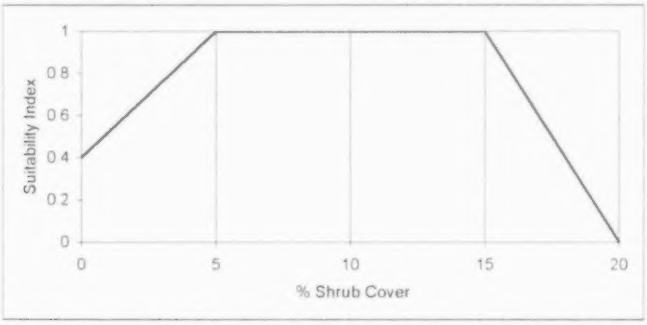


Figure 7.2 Habitat suitability index curve for percent shrub cover for the sharp-tailed grouse

8.0 HSI EQUATION

$$\mathbf{HSI = V_1 + (0.1V_2)}$$

The equation used to determine the overall HSI value assumes full value for V_1 (native prairie cover class) and 0.1 for V_2 (percent shrub cover). The native prairie cover represents nesting, hiding and brood rearing habitat and is the key variable in the model. Shrub cover represents a component of nesting habitat as well as winter habitat, however, because of the limitations of the NPVI database it is rated as 10% the value of V_1. The two variables are not interactive and are combined using the additive formula:

9.0 HABITAT SUITABILITY MAP

A habitat suitability map depicting the potential sharp-tailed grouse habitat within the Milk River Basin is found in Appendix G. The two largest areas of greatest habitat potential for sharp-tailed grouse are the Milk River Ridge to the west and the Sage Creek area in southeastern Alberta. There is a high density of leks on the Milk River Ridge but the density of leks in the Sage Creek area is relatively unknown. The map is a good representation of potential sharp-tailed grouse habitat.

10.0 LITERATURE CITED

Ammann, G.A. 1957. Prairie grouse in Michigan. Game Division, Department of Conservation, Lansing. 200 pp.

Bergerud, A.T. and M.W. Gratson.1988. Survival and breeding strategies of grouse. Pp. 473-577 IN: A.T. Bergerud and M.W. Gratson (eds.). Adaptive strategies and population ecology of northern grouse. VI.I – Population studies, Vol. II –Theory and synthesis. University of Minnesota Press, Minneapolis, MN.

Christenson, C.D. 1970. Nesting and brooding characteristics of sharp-tailed grouse (*Pedioecetes phasianellus jamesi* Lincoln) in southwestern North Dakota. Thesis, University of North Dakota, Grand Forks, North Dakota, USA.

Giesen, K.M. and J.W. Connelly. 1993. Guidelines for management of Columbia sharp-tailed grouse habitats. Wildlife Society Bulletin 21: 325-333.

Goddard, B. 1995. Sharp-tailed grouse habitat program and habitat retention programs in the white area. Proposal document, Alberta Natural Resources Service Buck for Wildlife Program, Edmonton, Alberta.

Hamerstrom, F.N. and F. Hamerstrom. 1961. Status and problems of North American grouse. Wilson Bulletin 51: 105-120.

Hillman, C.N. and W.W. Jackson. 1973. The sharp-tailed grouse in South Dakota.. South Dakota Department of Game, Fish and Parks, Department Technical Bulletin No. 3. 61 pp.

Johnsgard, P.A. 1973. Grouse and quails of North America. University of Nebraska Press, Lincoln, Nebraska, USA.

Johnsgard, P.A. 1975. North American game birds of upland and shoreline. University of Nebraska Press, Lincoln, Nebraska, USA.

Moyles, D.L.J. 1981. Seasonal and daily use of plant communities by sharp-tailed grouse (*Pedioecetes phasianellus*) in the parklands of Alberta. Canadian Field Naturalist 95: 287-291.

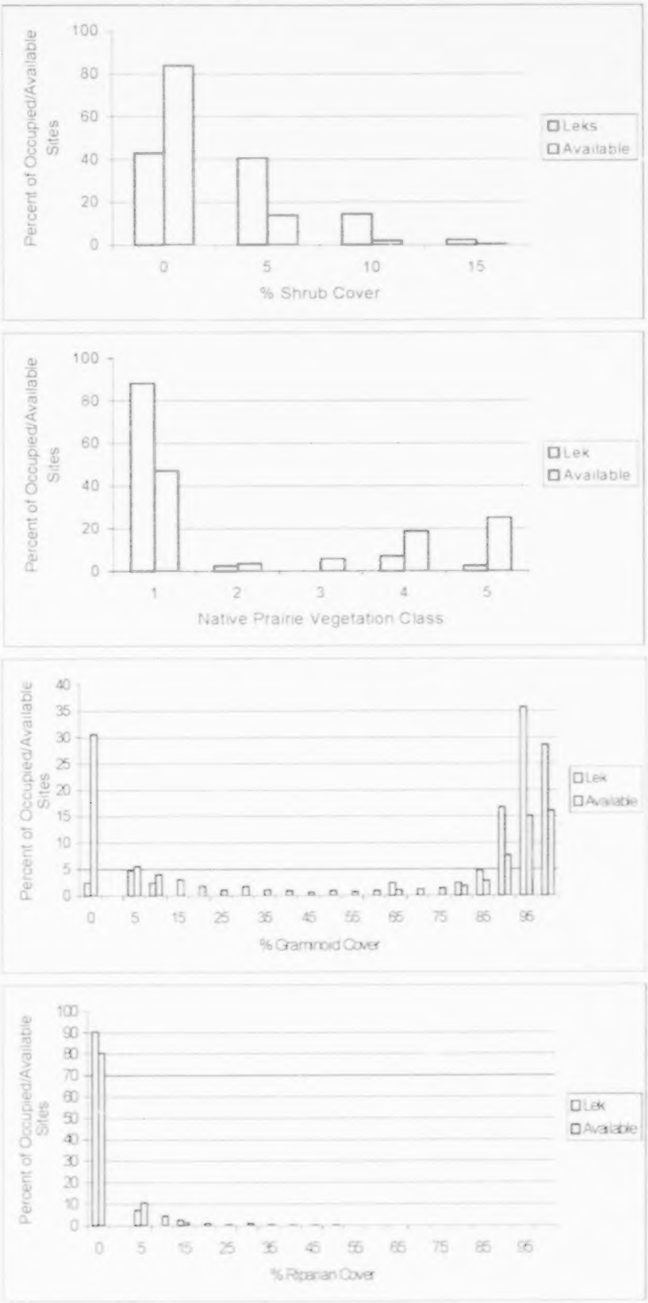
Pepper, G.W. 1972. The ecology of sharp-tailed grouse during spring and summer in the aspen parklands of Saskatchewan. Saskatchewan Department of Natural Resources, Wildlife Report Number One. 56 pp.

Prose, B.L. 1987. Habitat suitability index models: plains sharp-tailed grouse. U.S. Fish and Wildlife Service, Biological Report 82. 31 pp.

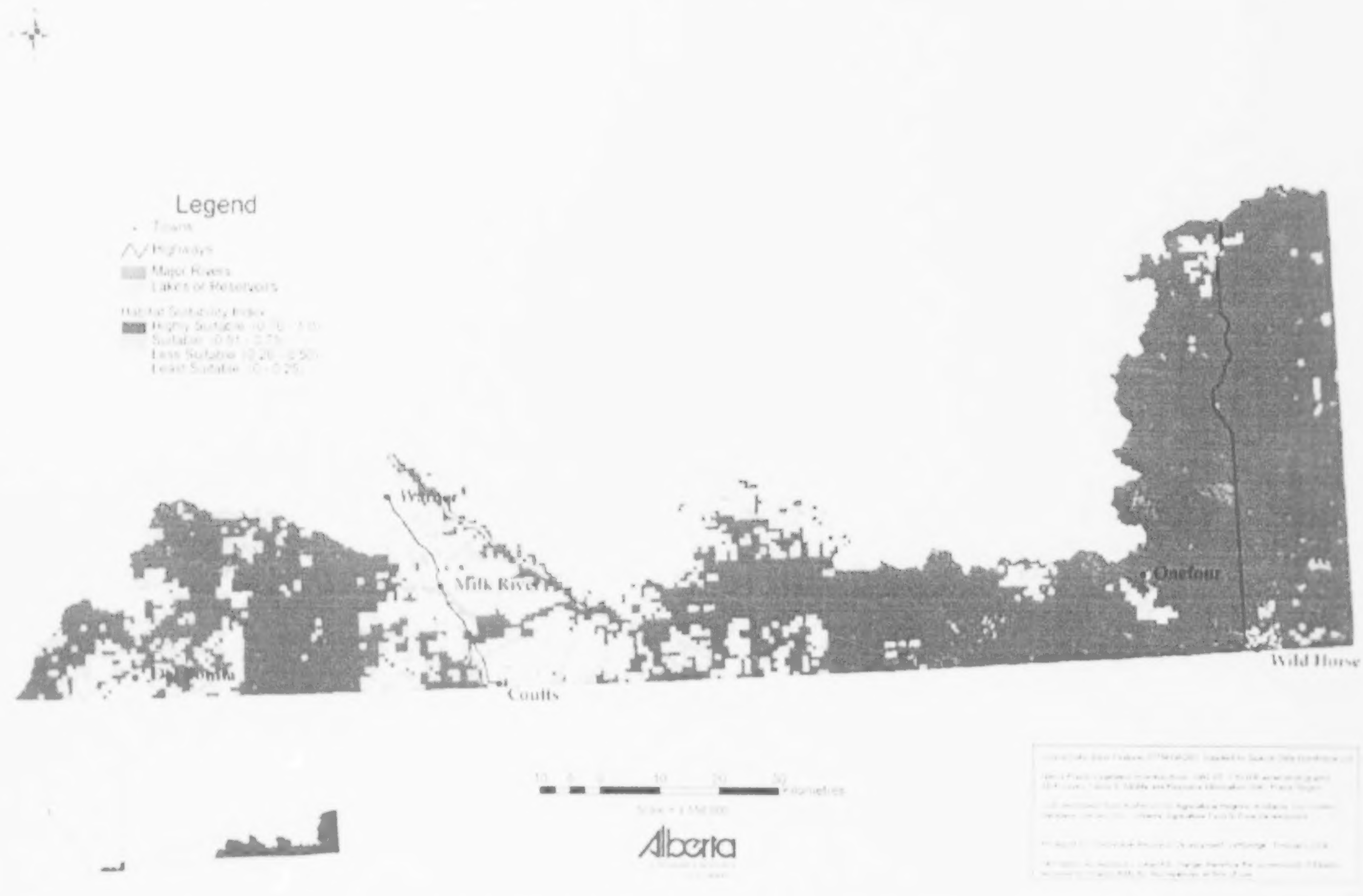
Roersma, S.J. 2001. Nesting and brood rearing ecology of plains sharp-tailed grouse (*Pedioecetes phasianellus jamesi*) in a mixed-grass/fescue ecoregion of southern Alberta. M.Sc. Thesis, University of Manitoba, Winnipeg, MB. 124 pp.

Swenson, J.E. 1985. Seasonal habitat use by sharp-tailed grouse *Pedioecetes phasianellus*, on mixed-grass prairie in Montana. Canadian Field Naturalist 99: 40-46.

Appendix F - Histograms of sharp-tailed grouse habitat variables for occupied sites (sharp-tailed grouse lek sites on the Milk River Ridge, n=42) and available sites (4219 quarter sections on the Milk River Ridge)



Appendix G - Potential habitat for the sharp-tailed grouse within the Milk River Basin


Legend
Towns
Highways
Major Rivers
Lakes or Reservoirs
Habitat Suitability Index
Highly Suitable (0.76 - 1.0)
Suitable (0.51 - 0.75)
Less Suitable (0.26 - 0.50)
Least Suitable (0 - 0.25)
Warner
Milk River
Coutts
Del Bonita
Onefour
Wild Horse
10 5 0 10 20 30 Kilometres
Alberta

SPRAGUE'S PIPIT (*Anthus spragueii*)

Julie P. Landry
Alberta Conservation Association, Lethbridge, AB

1.0 PURPOSE AND LIMITATIONS

The purpose of this model is to indicate potential nesting and foraging habitat for Sprague's pipit (*Anthus spragueii*) within the Milk River Basin. As this is a landscape level model with coarse variables, it may not be directly applicable to other areas or for site-specific analysis.

2.0 GENERAL DESCRIPTION

The Sprague's pipit is a songbird of the native grasslands (Sibley 2000), similar in appearance to sparrows such as the vesper sparrow (*Pooecetes gramineus*) and the Baird's sparrow (*Ammodramus bairdii*) (Salt and Wilk 1958). Distinguishing features include buff and streaked upper feathers (Semenchuk 1992), extensive white on its outer tail feathers (Sibley 2000), and a slender pointed beak (Salt and Wilk 1958). The Sprague's pipit has a distinctive song, which is sung from a high altitude and is a "rolling, jingling cascade of high, dry whistles" (Sibley 2000). Breeding occurs in southern Alberta, Saskatchewan, Manitoba, Minnesota, North Dakota, and Montana (Sibley 2000). This species migrates to wintering grounds in the southern United States and Mexico (Salt and Wilk 1958).

In Alberta, The General Status of Alberta Wild Species 2000 (Alberta Sustainable Resource Development 2001) designates the Sprague's pipit as a "Sensitive" species, while the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2001) has the Sprague's pipit classified as "Threatened."

3.0 HABITAT ASSOCIATIONS

3.1 Food

The Sprague's pipit is predominantly insectivorous, catching prey on or near the ground (Semenchuk 1992, Salt and Wilk 1958). In May, beetles comprise more than 40% of the adult diet and in September grasshoppers comprise 91% (Maher 1974, as cited in Prescott 1997). The nestling diet consists primarily of grasshoppers, but also may include lepidopteran larvae, leaf hoppers, spiders, and ants (Harris 1933, as cited in Prescott 1997).

3.2 Cover

The Sprague's pipit tends to occupy native grassland habitats (Wilson and Belcher 1989, Dale *et al.* 1997) containing very little or no woody vegetation (Davis and Duncan 1999, Dale 1983, as cited in Prescott 1997), with non-native areas populated to a significantly lower extent (Davis and Duncan 1999).

Research on these birds has shown them occupying grassland habitats with varying characteristics. Sutter *et al.* (1996) described that this bird forages in dense grassy vegetation, whereas, Sutter and Brigham (1998) identified occupied areas as sparse to intermediate in density with intermediate vegetation heights. In Saskatchewan, Sprague's pipits avoided heavily grazed areas and were positively associated with narrow-leafed grasses equal to or less than 10 cm tall, and were negatively associated with shrubs 20-100 cm tall (Anstey *et al.* 1995, as cited in Dechant *et al.* 2001). In North Dakota, if vegetation reached 8cm tall, Sprague's pipit incidence decreased by 50%, and decreased to less than 5% at vegetation heights of 19 cm (Madden *et al.* 2000). In addition, Sprague's pipits were completely absent from areas of deep litter (Sutter 1997) or dense nesting cover (Prescott and Murphy 1999) and from areas that had not seen fire disturbance for >80 years (Madden *et al.* 1999).

In Alberta, Owens and Myres (1973) found that Sprague's pipit were common on idle native prairie, and to a lesser extent were also found on lightly grazed native prairie with dense grasses. Sprague's pipits may also occasionally occupy grasslands that receive periodic disturbances such as fire, heavy grazing, and mowing (Owens and Myres 1973). In Alberta, Prescott and Murphy (1996) found that preferred areas had moderate cover diversity and moderate grass height and height variation.

3.3 Nesting Cover

Sprague's pipits build their nests on the ground in small depressions (McConnell *et al.* 1993) where grass is denser and taller, and where forb and shrub density is low (Sutter 1997). The nests are woven cups lined with coarse and fine graminoids (McConnell *et al.* 1993) and often have overarched grasses (Salt and Wilk 1958). In Saskatchewan, Sutter (1997) found nest sites had higher grass and sedge cover, lower forb and shrub cover, higher maximum vegetation height, lower bare ground cover, and lower forb density than found at random sites (Table 8.1).

Table 8.1 Nest characteristics of Sprague's pipit nest sites (n=47) in Saskatchewan (Sutter 1997)

Grass and Sedge Cover:	52.7%
Forb and Shrub Cover:	10.5%
Litter Cover:	15.2%
Bare Ground Cover:	16.8%
Maximum Height:	27.7cm
Litter Depth:	2.4cm

4.0 HABITAT AREA REQUIREMENTS

Predominantly, Sprague's pipits have been recorded on larger tracts of native prairie (Owens and Myres 1973). For example, in Saskatchewan the minimum area required was 190 ha (Saskatchewan Wetland Conservation Corporation 1997, as cited in Dechant *et al.* 2001). Kantrud (1981) found the amount of grazing an area received as well as land usage type depicted how many pairs may occupy an area.

It is interesting to note that in Manitoba, brown-headed cowbird brood parasitism was higher on smaller tracts of land (22 ha) than on larger ones (64 ha) (Davis and Sealy 2000, as cited in Dechant *et al.* 2001).

5.0 ASSOCIATED SPECIES

A few species associated with the Sprague's pipit include the Baird's sparrow (*Ammodramus bairdii*), grasshopper sparrow (*Ammodramus savannarum*), Le Conte's sparrow (*Ammodramus leconteii*), western meadowlark (*Sturnella neglecta*) (Madden *et al.* 1999), and chestnut-collared longspur (*Calcarius ornatus*) (Davis and Duncan 1999).

6.0 THE HSI MODEL

6.1 Assumptions and Limitations

- It will be assumed that all water requirements are attained through consumption of insects because no water requirements have been documented for this species.
- Since vegetation height, density, and grass to forb ratio could not be determined for this model, it will be assumed that within native grasslands the variability needed for foraging and nesting will be available.
- Within each quarter section, the native prairie coverage cannot determine if the percent of native grass is contiguous or not. Upon ground truthing, highly suitable areas may not be as suitable as once determined. For our purposes, we will assume native grass is contiguous within each quarter section.

6.2 Selected Habitat Variables

6.2.1 Percent Native Grass (V_1)

In Alberta, Prescott and Wagner (1996) observed that Sprague's pipit were 15 times more common on native fescue or mixed-grass prairie than in tame pastures or agricultural fields. For this model, areas comprised of 25% or more native grass were assigned a suitability value of 1. Since non-native areas are not completely devoid of Sprague's pipits, zero percent native grass areas did not receive a habitat suitability value of zero but received a low suitability of 0.1. As native grassland percent cover increases from zero, the suitability increases (Figure 8.1).

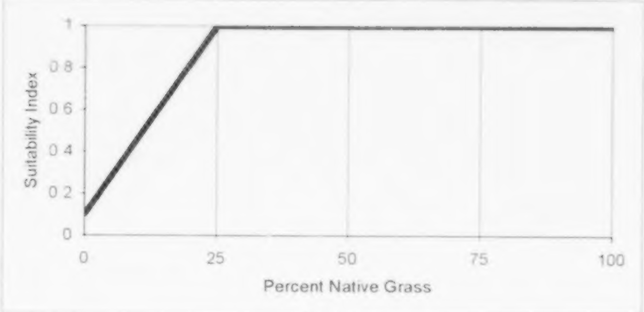


Figure 8.1 Habitat suitability index for percent native grass coverage for the Sprague's pipit

6.2.2 Percent Trees and Shrubs (V_2)

To satisfy nesting and foraging requirements, Sprague's pipits require open grasslands with little or no amounts of woody vegetation (Davis and Duncan 1999). If woody vegetation increases above 15%, the habitat is no longer considered suitable (Prescott, pers.comm.) (Figure 8.2).

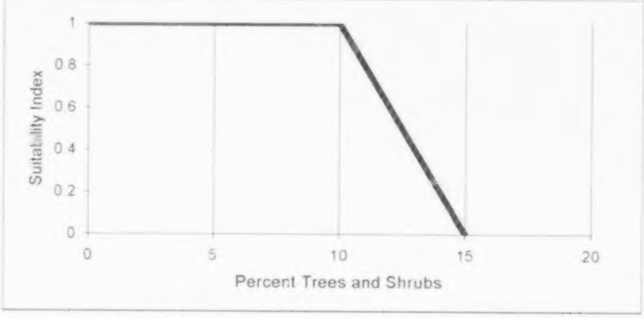


Figure 8.2 Habitat suitability index for percent tree and shrub cover for the Sprague's pipit

6.2.3 Distance from Riparian Areas (V_3)

To further satisfy the Sprague's pipit's preference for open grasslands, riparian areas, which potentially contain woody vegetation, will be considered unsuitable habitat (Prescott, pers.comm.) (Figure 8.3).

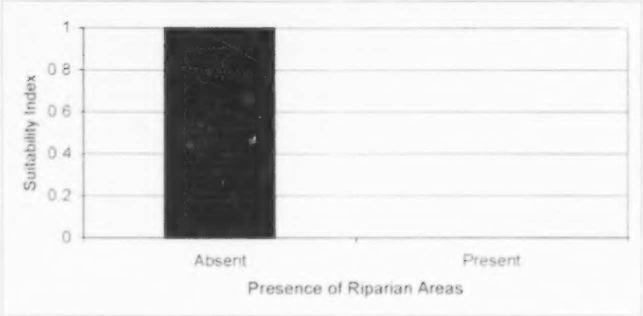


Figure 8.3 Habitat suitability index for riparian areas for the Sprague's pipit

7.0 HSI EQUATION

$$HSI = (V_1 * V_2 * V_3)$$

The equation used for evaluating nesting and foraging habitat for Sprague's pipits considers the 3 variables to be equal and non-compensatory. A low value in one of the variables cannot be compensated by a higher value in another. This equation describes a full interaction between the 3 variables, indicating that the use of native grasses as reproductive habitat only occurs where shrub and tree cover is low or nil.

7.1 Other Variables Considered

7.1.1 Grass Height

There was no available database containing information on grass heights. This variable would have been useful in selecting more specific nesting areas for Sprague's pipits (Sutter 1997).

8.0 SOURCES OF OTHER MODELS

One other habitat suitability model for the Sprague's pipit was created for the M.D. of Foothills No. 31 (Kienzle and Landry 2002).

9.0 HABITAT SUITABILITY MODEL

Please refer to Appendix H for a colour map that portrays the potential breeding, nesting, and foraging habitat for the Sprague's pipit within the Milk River Basin. This map was produced with the three habitat variables used in the HSI equation: percent native grass, percent trees and shrubs, and presence of riparian areas. Four different suitability ratings, ranging from "highly suitable" to "least suitable," were categorized on the landscape. Large contiguous areas of potentially highly suitable habitat for Sprague's pipits are found west of Highway 4, and in the southeastern portion of the Milk River Basin. The largest white area on the map from the Warner area and south to Coutts predominantly indicates agricultural land, which has been identified as the least suitable habitat for the Sprague's pipit. If additional information regarding microhabitat for the Sprague's pipit (*e.g.* grass height and density) were acquired, highly suitable habitat areas could be more refined.

10.0 LITERATURE CITED

Alberta Sustainable Resource Development. 2001. The General Status of Alberta Wild Species 2000. Alberta Sustainable Resource Development, Fish and Wildlife Service, Edmonton, AB. 46 pp. Publ. No.I/023.

Anstey, D.A., S.K. Davis, D.C. Duncan, and M. Skeel. 1995. Distribution and habitat requirements of eight grassland songbird species in southern Saskatchewan. Saskatchewan Wetland Conservation Corporation, Regina, Saskatchewan. 11 pp.

COSEWIC. 2001. Canadian species at risk, November 2001. Committee on the Status of Endangered Wildlife in Canada. 32 pp.

Dale, B.C. 1983. Habitat relationships of seven species of passerine birds at Last Mountain Lake, Saskatchewan. Unpubl. M.Sc. thesis, Univ. Regina, Regina, SK. 119 pp.

Dale, B.C., P.A., Martin, and P.S. Taylor. 1997. Effects of hay management on grassland songbirds in Saskatchewan. Wildlife Society Bulletin 25(3): 616-626.

Davis, S.K. and D.C. Duncan. 1999. Grassland songbird occurrence in native and crested wheatgrass pastures of southern Saskatchewan. Studies in Avian Biology 19: 211-218.

Davis, S.K., and S.G. Sealy. 2000. Cowbird parasitism and nest predation in fragmented grasslands of southwestern Manitoba. Pp. 220-228 IN: J. N. M. Smith, T. L. Cook, S. I. Rothstein, S. K. Robinson, and S. G. Sealy, editors. Ecology and management of cowbirds and their hosts. University of Texas Press, Austin, Texas.

Dechant, J.A., M.L. Sondreal, D.H. Johnson, L.D. Igl, C.M. Goldade, M.P. Nenneman, and B.R. Euliss. 2001. Effects of management on grassland birds: Sprague's pipit. Northern Prairie Wildlife Research Center, Jamestown, ND. Jamestown, ND, Northern Prairie Wildlife Research Center, Home Page. http://www.npwrc.usgs.gov/resource/literatr/grasbird/pipit/pipit.htm

Harris, R.D. 1933. Observations on a nest of Sprague's pipit (*Anthus spragueii*). Canadian Field Naturalist 47: 91-95.

Kantrud, H.A. 1981. Grazing intensity effects of the breeding avifauna of North Dakota native grasslands. Canadian Field Naturalist 95(4): 404-417.

Kienzle, S.T. and J.Landry. 2002. Bird habitat modelling in the municipal district of Foothills No. 31. Unpublished Report. Department of Geography, University of Lethbridge for the M.D. Foothills No.31. 54 pp.

Madden, E.M., A.J. Hansen, and R.K. Murphy. 1999. Influence of prescribed fire history on habitat and abundance of passerine birds in northern mixed-grass prairie. Canadian Field Naturalist 113(4): 627-640.

Madden, E.M., R.K. Murphy, A.J. Hansen, and L. Murray. 2000. Models for guiding management of prairie bird habitat in Northwestern North Dakota. American Midland Naturalist 144: 377-392.

Maher, W. J. 1974. Matador project. Birds: III. Food habits. Canadian Committee for the International Biological Programme Tech. Rept. No. 52, Saskatoon, SK. 107 pp.

McConnell, S.D., D.R. Vandendriessche, T.D. Hooper, G.L. Roberts, and A. Roberts. 1993. First occurrence and breeding of Sprague's pipit, *Anthus spragueii*, for British Columbia. Canadian Field Naturalist 107: 222-223.

Owens, R.A., and M.T. Myres. 1973. Effects of agriculture upon populations of native passerine birds of an Alberta fescue grassland. Canadian Journal of Zoology 51: 697-713.

Prescott, D.R.C. 1997. Status of the Sprague's pipit (*Anthus spragueii*) in Alberta. Alberta Environmental Protection, Wildlife Management Division, Wildlife Status Report No. 10, Edmonton, AB. 14 pp.

Prescott, D.R.C., and A.J. Murphy. 1996. Habitat associations of grassland birds on native and tame pastures of the aspen parkland in Alberta. NAWMP-02. Alberta NAWMP Centre, Edmonton, Alberta. 36 pp.

Prescott, D.R.C., and A.J. Murphy. 1999. Bird populations of seeded grasslands in the aspen parkland of Alberta. Studies in Avian Biology 19: 203-210.

Prescott, D.R.C., and G.M. Wagner. 1996. Avian responses to implementation of a complementary/rotational grazing system by the North American Waterfowl Management Plan in southern Alberta: the Medicine Wheel project. Alberta NAWMP Centre. NAWMP-018. Edmonton, AB. 24 pp.

Salt, W.R. and A.L. Wilk. 1958. The Birds of Alberta. Lithographed by Hamly Press Ltd., Edmonton, AB. 511 pp.

Saskatchewan Wetland Conservation Corporation (SWCC). 1997. Grassland bird conservation through Saskatchewan's native prairie stewardship program. Saskatchewan Wetland Conservation Corporation, Regina, Saskatchewan.

Semenchuk, G. P. 1992. The Atlas of breeding birds of Alberta. Federation of Alberta Naturalists, Edmonton, Alberta.

Sibley, D.A. 2000. National Audubon Society. The Sibley Guide to Birds. Alfred A Knopf, Inc., New York. 545 pp.

Sutter, G.C. 1997. Nest-site selection and nest-entrance orientation in Sprague's pipit. Wilson Bulletin 109(3): 462-469.

Sutter, G.C., and R.M. Brigham. 1998. Avifaunal and habitat changes resulting from conversion of native prairie to crested wheat grass: patterns at songbird community and species levels. Canadian Journal of Zoology 76: 869-875.

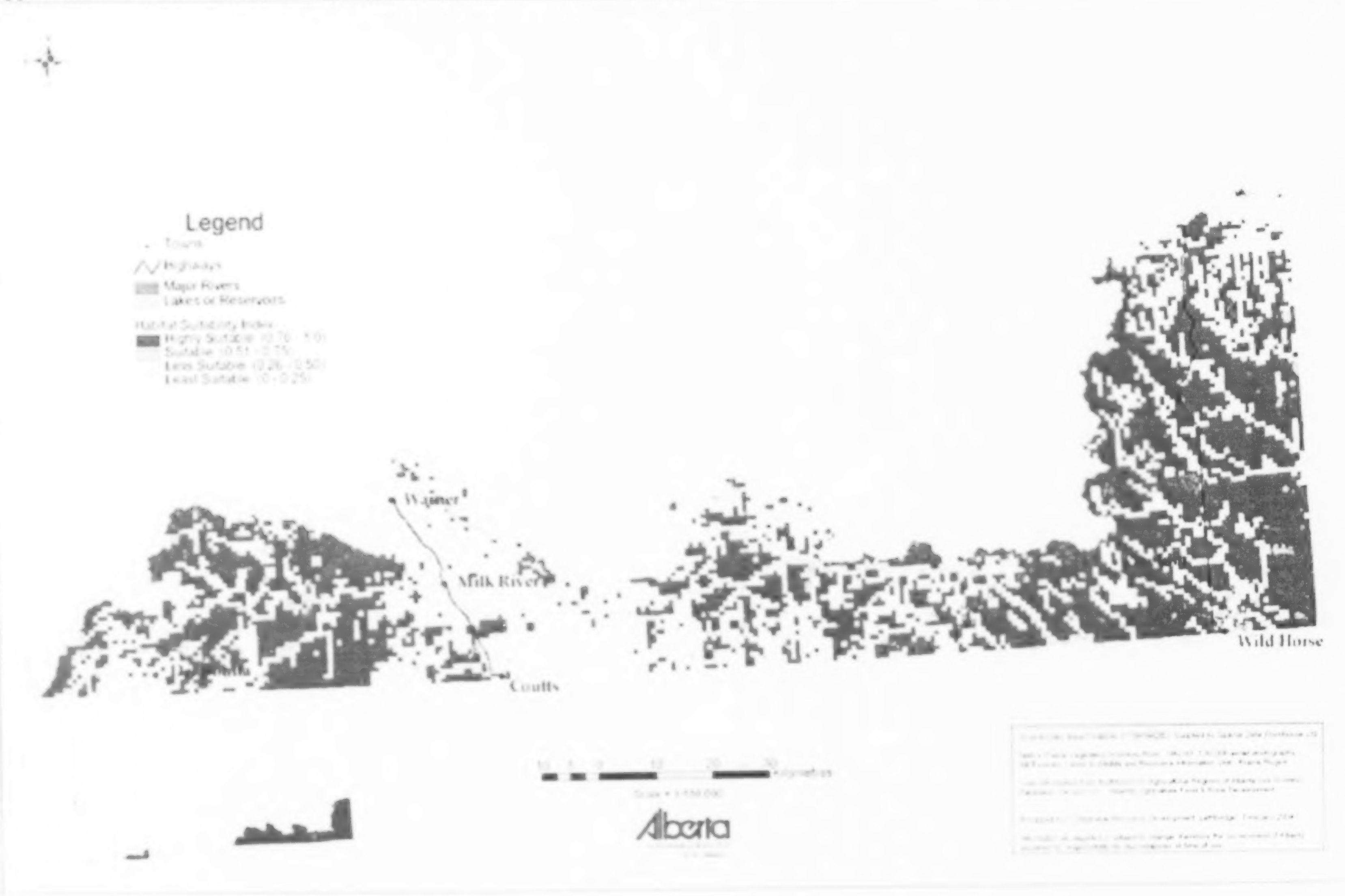
Sutter, G.C., D.J. Sawatzky, D.M. Cooper, and R.M. Brigham. 1996. Renesting intervals in Sprague's pipit, *Anthus spragueii*. Canadian Field Naturalist 110: 694-697.

Wilson, S.D., and J.W. Belcher. 1989. Plant and bird communities of native prairie and introduced Eurasian vegetation in Manitoba, Canada. Conservation Biology 3(1): 39-44.

11.0 PERSONAL COMMUNICATIONS

Prescott, David R. Regional Endangered Species Biologist, Parkland Region, Alberta Sustainable Resource Development, Fish and Wildlife Division, Red Deer, AB.

Appendix H - Potential habitat for Sprague's pipit within the Milk River Basin


Legend
Towns
Highways
Major Rivers
Lakes or Reservoirs
Habitat Suitability Index
Highly Suitable (0.76 - 1.0)
Suitable (0.51 - 0.75)
Less Suitable (0.26 - 0.50)
Least Suitable (0 - 0.25)
Warner
Milk River
Coutts
Wild Horse
10 5 0 10 20 30 Kilometres
Scale = 1:550,000
Alberta

AMERICAN BADGER *(Taxidea taxus)*

Brad A. Downey
Alberta Conservation Association, Lethbridge, AB

1.0 PURPOSE AND LIMITATIONS

The purpose of this model is to indicate potential habitat for the American badger (*Taxidea taxus)* within the Milk River Basin. As this is a landscape level model with coarse variables, it may not be directly applicable to other areas or for site-specific analysis.

2.0 GENERAL INFORMATION

The American badger's range extends from south central Canada to Mexico and from the West Coast east to Illinois and Missouri (Neal and Cheeseman 1996). Four sub-species have been identified for the American badger, with *Taxidea taxus taxus* being found in Alberta and classified as "Sensitive" due to its local distribution (Alberta Sustainable Resource Development 2001). The badger is a solitary fossorial (burrowing) carnivore (Apps *et al.* 2002) identified by its wedge shaped head, small ears, short legs, flatish body, and stocky appearance. Its upper body can vary from reddish brown to grey and has a prominent white stripe that runs from the tip of its nose to the nape of the neck (Neal and Cheeseman 1996). The head has dark patches on the cheeks with a white patch between the cheeks and crown. The feet are dark brown with long curved claws, which can dig a hole to elude predators in less than a minute. Adult badgers can weigh from 4 – 12 kg and measure between 520mm-875mm in length (Neal and Cheeseman 1996, Messick and Hornocker 1981).

3.0 GENERAL HABITAT ASSOCIATIONS

3.1 Food

Badgers are mainly carnivorous, hunting fossorial and semi-fossorial prey. They usually have one main prey source but are also opportunistic and will eat invertebrates, cereal crops, birds, eggs, reptiles, amphibians and other mammals (Neal and Cheeseman 1996, Messick and Hornocker 1981, Apps *et al.* 2002). Stomach samples taken from badgers also found them to scavenge carrion such as cattle, lagomorphs, and roadkill (Messick and Hornocker 1981, Sovada *et al.* 1999). Time of year and the maturity of the badger also influence the availability and selection of food (Sovada *et al.* 1999).

Badgers catch most of their prey by digging them out, as evidenced by mounds of dirt and large holes found among ground squirrel (*Spermophilus spp.*) and pocket gopher (*Thomomys talpoides*) colonies; on rare occasions fossorial prey are caught above ground. Abundance of key prey species like Richardson's ground squirrels and pocket gophers can affect badger populations (Scobie 2002).

3.2 Cover

Badgers are often found in open grasslands with friable soils, few to no shrubs/trees, and within close proximity to a food source (Scobie 2002, Messick and Hornocker 1981, Newhouse and Kinley 1999). On preferred badger habitat Apps *et al.* (2002) found a positive association with linear disturbances, fine sandy-loam textured soils, open habitat, and glaciofluvial deposits. A negative habitat association was found with gravelly areas, forest cover, elevation, and colluvial deposits. Newhouse (1999) also found that badgers tended to use sandy loam and silty loam soils. Areas having a combination of irrigated agriculture and native vegetation seemed to support more ground squirrels, and therefore likely also more badgers, than areas with only native vegetation (Todd 1980). Badger burrows have also been found within close proximity of roadways (Newhouse and Kinley 1999, Messick and. Hornocker 1981), however roadways have proven to be detrimental to badgers, resulting in road kills. Loss of badger habitat occurred where shrubs and woody vegetation were encroaching onto grasslands due to fire suppression (Scobie 2002), but habitat increased in some areas where forest habitat had been cleared away (Newhouse and Kinley 1999).

4.0 HABITAT AREA REQUIREMENTS

Home ranges for badgers vary across North America, but it is known that males have larger ranges than females. All live relatively solitary lives with some overlap of home ranges between opposite sex and age classes (Messick and Hornocker 1981). Weir and Hoodicoff (2002) found that male badgers in the Thompson and Okanagan regions of British Columbia had home ranges of 79.1 km^2.

5.0 ASSOCIATED SPECIES

A strong correlation was found between badger burrows and Townsend ground squirrel *(Spermophilus townsendii)* holes in a study conducted in Idaho (Messick and Hornocker 1981). Badger burrows were also found within 50m of Columbian ground squirrel (*Spermophilus columbianus*) burrows in British Columbia (Newhouse 1999). The same correlation may be true for Richardson's ground squirrels in Alberta which badgers have a close association with (Smith 1993). Burrowing owls (*Athene cunicularia*), swift foxes (*Vulpes velox*), and prairie rattlesnakes (*Crotalus viridis*) make use of old badger dens and excavations. Ferruginous hawks (*Buteo regalis*), prairie falcons (*Falco mexicanus*), and long tailed weasels (*Mustela frenata*) compete with badgers for Richardson's ground squirrels.

6.0 THE HSI MODEL

6.1 Selected Habitat Variables

6.1.1 Soil Texture (V_1)

Soil textures were grouped into one of five categories (Table 9.1) as separated in Brady and Weil (1999). Newhouse (1999) found badgers to prefer sandy loam and silty loam, medium and moderately coarse textured soils (Figure 9.1).

Table 9.1 Soil texture classifications

Soil Texture Classification	Symbol	Soil Textures Included
Coarse	C	Sand, Loamy sand
Moderately Coarse	MC	Sandy loam
Medium	M	Loam, Silt loam, Silt
Moderately Fine	MF	Sandy clay loam, Silty clay loam, Clay loam
Fine	F	Sandy clay, Silty clay, Clay

Footnote 1- U.S. Department of Agriculture Classification System adapted from Brady and Weil (1999)

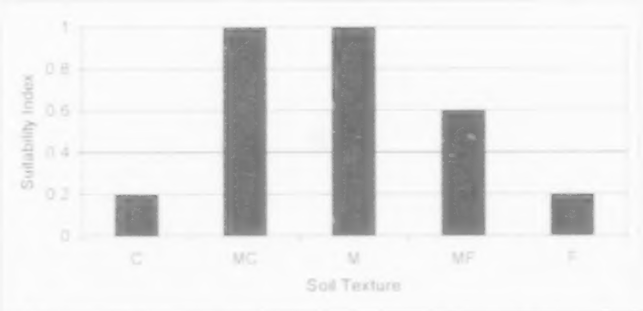


Figure 9.1 Habitat suitability index for soil texture for the American badger

6.1.2 Graminoid Coverage (V_2)

Badgers generally prefer open grassland habitat (Scobie 2002, Apps *et al.* 2002, Messick and Hornocker 1981), but can also be found in agriculturally dominated landscapes containing isolated pockets of Richardson's ground squirrel colonies. Twenty- percent graminoid coverage was chosen as the minimum requirement for suitable badger habitat (Figure 9.2).

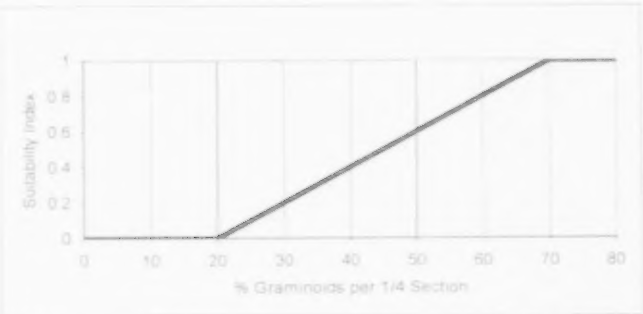


Figure 9.2 Habitat suitability index for graminoid coverage for the American badger

6.1.3 Slope (V_3)

As slope increases, habitat suitability decreases to a point at which the likelihood of badgers existing there (i.e. cliffs and badlands) is extremely low to nil. After examining the coarse data used for mapping, a slope of ≤15 degrees was determined to be the most representative of suitable American badger habitat in the Milk River Basin (Figure 9.3). Slope will vary within other regions depending on the refinement of the data layer.

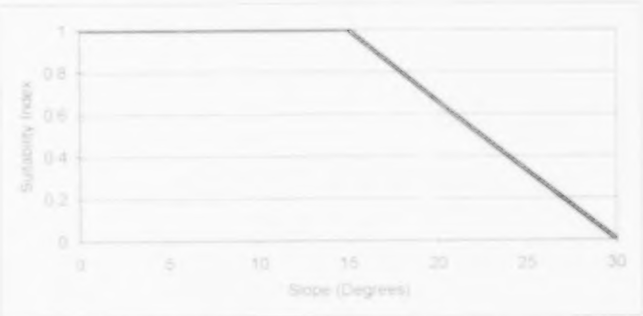


Figure 9.3 Habitat suitability index for slope for the American badger

6.1.4 Roadways (V_4)

The fact that so many badgers die as a result of vehicle collisions prevents habitat close to main roads as being suitable (Weir and Hoodicoff 2002, Messick and Hornocker 1981). Habitat further away from main roads which contains ground squirrels and open grassland are the most beneficial to protect. Roads received a 400m buffer, with HSI values within the buffer zone lower than the rest of the quarter section; the degree to which the value was lowered was dependent upon the road type (Figure 9.4).

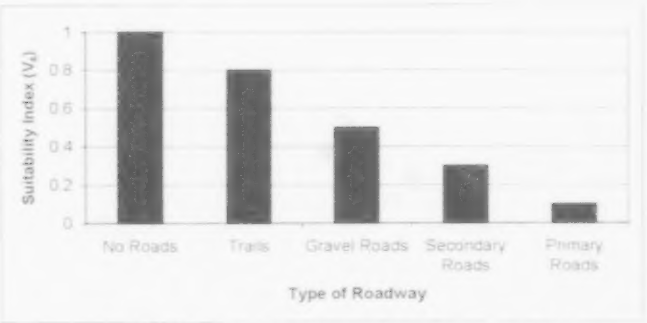


Figure 9.4 Habitat suitability index for the American badger

7.0 HSI EQUATION

$$HSI = (V_1 * V_2 * V_3 * V_4)$$

All four variables (slope, graminoids, soil, and roadways) were considered equal and non-compensatory so that the absence or negative effects of one variable would change the final HSI value of the ¼ section. The ¼ sections containing steep slopes, which are impassable by badgers, were given lower values. The ¼ sections containing less than 70% graminoids are probably subject to more disturbances and also received lower values, as badgers prefer a more open and less disturbed environment. Soils considered too coarse or too fine for badger habitat also received lower HSI values; soils that are too fine result in their burrows collapsing, and soils that are too coarse indicate probable roadways and also lower success of burrow construction.

8.0 HABITAT SUITABILITY MAP

Please refer to Appendix I for potential habitat for the American badger within the Milk River Basin. The map indicates highly suitable areas were burrow development could occur however badgers may still be seen wandering through less suitable habitat.

9.0 LITERATURE CITED

Alberta Sustainable Resource Development. 2001. The general status of Alberta wild species 2000. Alberta Sustainable Resource Development, Fish and Wildlife Service, Edmonton, AB. 46 pp. Publ. No. I/023

Apps, C. D., N. J. Newhouse, and T. A. Kinley. 2002. Habitat associations of American badgers in southeastern British Columbia. Can. J. Zool. 80: 1228-1239.

Brady, N. C. and R. R. Weil. 1999. The Nature and Properties of Soils- Twelfth edition. Prentice Hall Inc. Upper Saddle River, New Jersey, U.S.A. 881 pp.

Messick, J. P. and M. G. Hornocker. 1981. Ecology of the badger in southwestern Idaho. Wildlife Monographs 76: 1-53.

Michener, G. R. and A. N. Iwaniuk. 2001. Killing technique of North American badgers preying on Richardson's ground squirrels. Can. J. Zool. 79: 2109-2113.
Neal, E. and C. Cheeseman. 1996. Badgers. T & A D Poyser Ltd. London, England. p. 271.

Newhouse, N. and T. Kinley. 1999. Update COSEWIC status report on American badger (*Taxidea taxus*). Committee on the Status of Endangered Wildlife in Canada (COSEWIC), Ottawa, ON. 28 pp.

Scobie, D. 2002. Status of the American Badger (*Taxidea taxus*) in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division, and Alberta Conservation Association, Wildlife Status Report No. 43, Edmonton, AB. 17 pp.

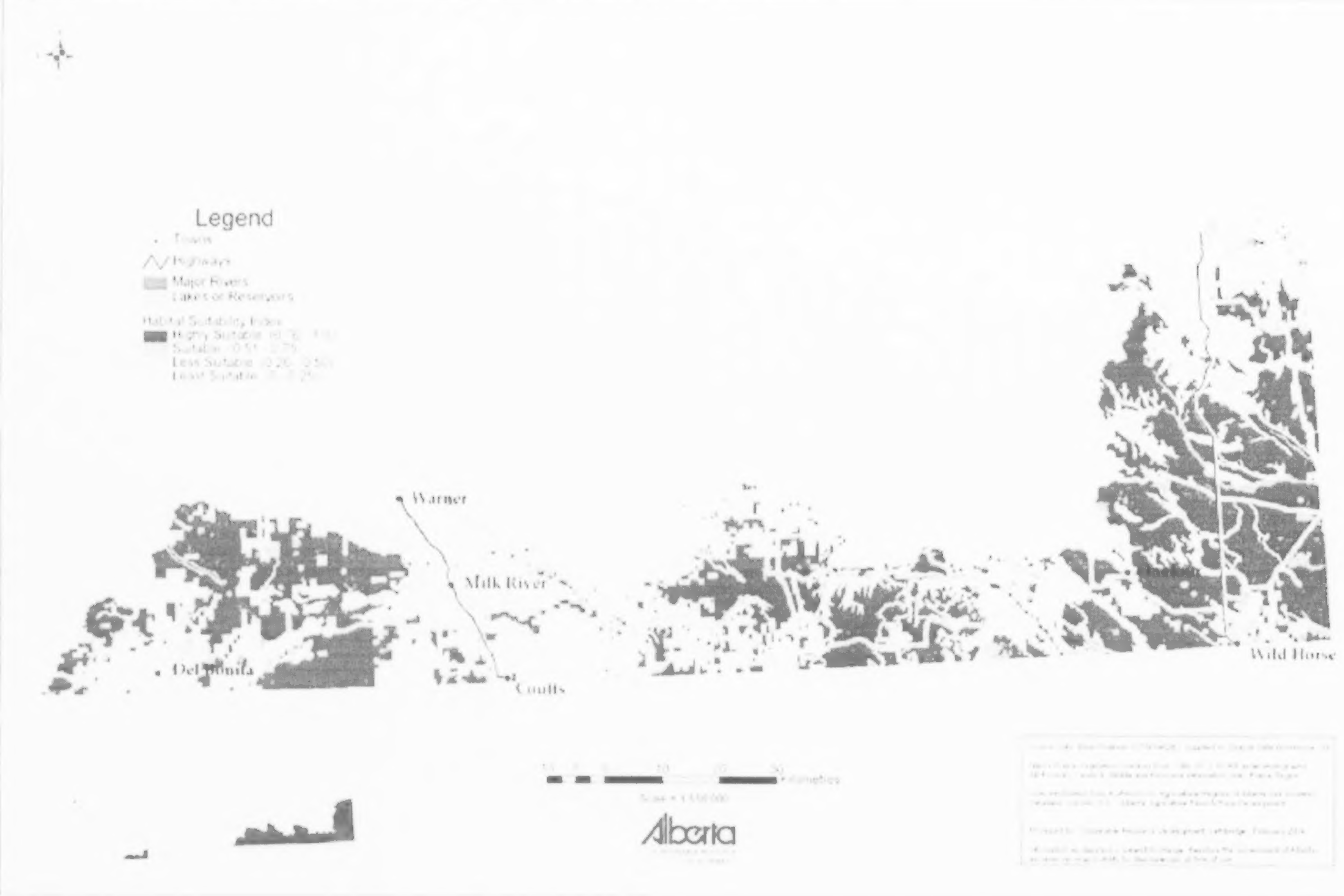
Smith, H. C. 1993. Alberta Mammals- An Atlas and Guide. Provincial Museum of Alberta, Edmonton, Alberta. p. 238.

Sovada, M. A., J. M. Roaldson, and A. B. Sargeant. 1999. Foods of American Badgers in West-central Minnesota and Southeastern North Dakota During the Duck Nesting Season. American Midland Naturalist 142 (2): 410-414.

Todd, M. C. 1980. Ecology of badgers in south-central Idaho, with additional notes on raptors. Thesis, University of Idaho, Moscow, Idaho, USA.

Weir, R. D. and C. Hoodicoff. 2002. Development of conservation strategies for badgers in the Thompson & Okanagan Regions. 2001-2002 Annual Report, University of Victoria, Victoria, BC, Canada.

Appendix I - Potential habitat for American badger within the Milk River Basin


Legend
Towns
Highways
Major Rivers
Lakes or Reservoirs
Habitat Suitability Index
Highly Suitable (0.76 - 1.0)
Suitable (0.51 - 0.75)
Less Suitable (0.26 - 0.50)
Least Suitable (0 - 0.25)
Warner
Milk River
Coutts
Del Bonita
Wild Horse
10 5 0 10 20 30
Kilometres
Alberta

OLIVE-BACKED POCKET MOUSE *(Perognathus fasciatus)*

David L. Gummer
Provincial Museum of Alberta, Edmonton, AB
&
Kelley J. Kissner
Alberta Fish and Wildlife, Medicine Hat, AB

1.0 PURPOSE AND LIMITATIONS

The purpose of this model is to indicate potential habitat for olive-backed pocket mice (*Perognathus fasciatus*) within the Milk River Basin. As this is a landscape level model with coarse variables, it may not be directly applicable to other areas or for site-specific analysis.

2.0 GENERAL INFORMATION

The olive-backed pocket mouse is a tiny, nocturnal mouse that is widely distributed in the arid grasslands of the Great Plains (Manning and Jones 1988). In Alberta, the General Status of Alberta Wild Species 2000 designates the olive-backed pocket mouse as a "Sensitive" species due to a relatively low number of documented occurrences in the province and its reliance on grassland habitat (Alberta Sustainable Resource Development 2001).

Olive-backed pocket mice are primarily granivorous, solitary, and highly fossorial. They have short, dark, sandy-brown dorsal pelage and white ventral pelage, with a thin cream-coloured lateral line (Smith 1993). Olive-backed pocket mice have external, fur-lined cheek pouches on each side of the mouth. They weigh 11 to 14 g and measure 112 to 132 mm in total length (Smith 1993).

The underground burrows of olive-backed pocket mice lead 30 to 200 cm below the soil surface and may occupy an area up to 6 metres in diameter (Manning and Jones 1988). Burrow entrances and tunnels average about 20 mm in diameter. Olive-backed pocket mice hibernate for 6 to 8 months per year. They are not active above ground during autumn, winter or early spring.

3.0 GENERAL HABITAT ASSOCIATIONS

3.1 Food

Olive-backed pocket mice are mainly granivorous, collecting plant seeds in their cheek pouches and storing them in their underground chambers and tunnels (Manning and Jones 1988). They also collect and eat small amounts of green vegetation and invertebrates (e.g. grasshopper eggs).

3.2 Cover

Olive-backed pocket mice are found in open, dry grasslands with loose, sandy, or sparsely vegetated soils and an abundance of plant seeds (Gummer and Kissner, unpubl. data, Manning and Jones 1988, Reynolds *et al.* 1999, Gummer and Robertson 2003). They are not found in wetland or riparian habitats. Olive-backed pocket mice may prefer sites with low densities of shrubs to provide cover from large and aerial predators (owls). Only four observations of olive-backed pocket mice have been made in the vicinity of the Milk River.

4.0 HABITAT AREA REQUIREMENTS

Olive-backed pocket mice presumably have very small home ranges; the species' largest documented movements are less than 100 m (Prefaur and Hoffman 1975). Individual mice spend the majority of their time in their underground burrow complexes, which appear to be relatively small (less than 10 m in diameter; Manning and Jones 1988).

5.0 ASSOCIATED SPECIES

No known species associations are relevant to the vicinity of the Milk River. In other areas of Alberta, olive-backed pocket mice are abundant in sandy-soiled habitats in which Ord's kangaroo rats (*Dipodomys ordii*) are more conspicuous and easier to detect (Gummer and Kissner unpubl. data); however, kangaroo rats are not known to occur in the Milk River drainage (Gummer and Robertson 2003).

6.0 THE HSI MODEL

The small home range size of olive-backed pocket mice suggests that small-scale (site) characteristics likely determine habitat use by this species. Evaluation of the following variables at areas greater than one hectare may limit the usefulness of the model in identifying potential habitat for olive-backed pocket mice.

6.1 Selected Habitat Variables

6.1.1 Soil Texture (V_1)

Olive-backed pocket mice are not strong diggers and lack adaptations for digging (e.g. strong jaw and forelimbs) present in many other fossorial rodents. Consequently, they prefer loose, sandy soil that facilitates easy burrowing (Figure 10.1).

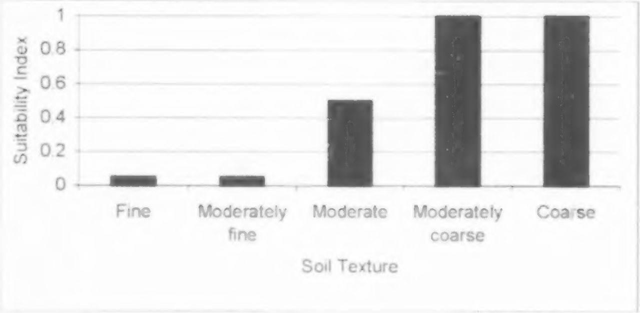


Figure 10.1 Soil texture habitat suitability index for the olive-backed pocket mouse

6.1.2 Percent Bare Ground per Hectare (V_2)

Olive-backed pocket mice use a hopping-style of locomotion. Bare, open ground allows them to move quietly through their habitat, reducing their risk of predation (Figure 10.2)

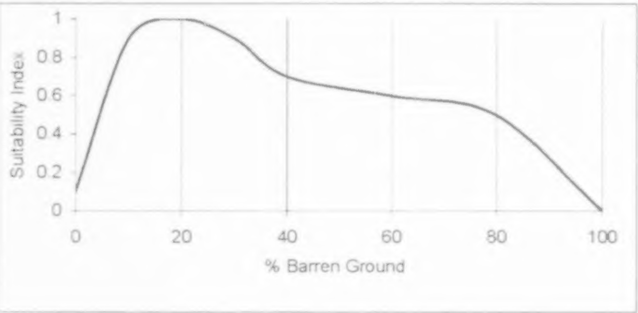


Figure 10.2 Percent barren ground habitat suitability index for the olive-backed pocket mouse

6.1.3 Percent Graminoids per Hectare (V_3)

The diet of olive-backed pocket mice consists mainly of native plant seeds, which are abundant in grassland habitat (Figure 10.3).

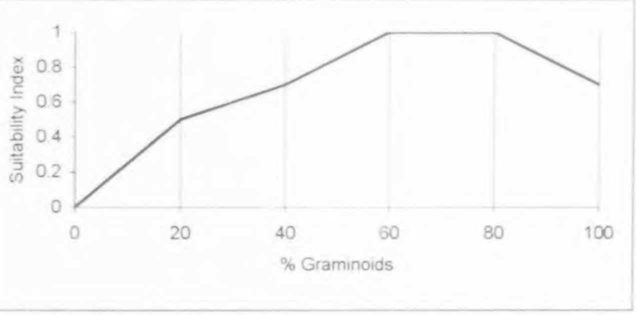


Figure 10.3 Percent graminoid coverage habitat suitability index for the olive-backed pocket mouse

6.1.4 Percent Shrubs per Hectare (V_4)

Olive-backed pocket mice appear to prefer sites with low densities of shrubs to provide cover from large and aerial predators (owls). Moderate and high densities of shrubs may limit their foraging opportunities and their ability to move quietly through the habitat (Figure 10.4).

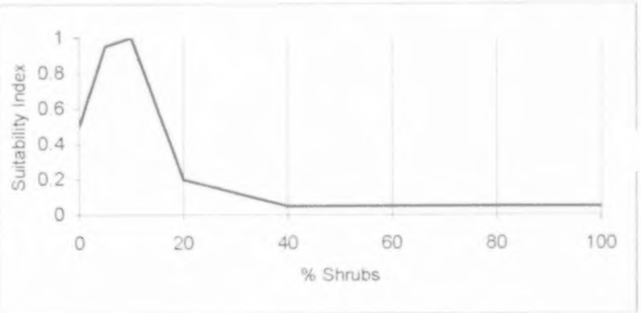


Figure 10.4 Percent shrub coverage habitat suitability index for the olive-backed pocket mouse

6.1.5 Habitat Type (V_5)

Olive-backed pocket mice occur only in grassland habitat. Pocket mice are not known to swim, and rivers may act as barriers to their movement. Pocket mice are also not associated with riparian areas due to the higher shrub component and less workable soils characteristic of these areas (Figure 10.5).

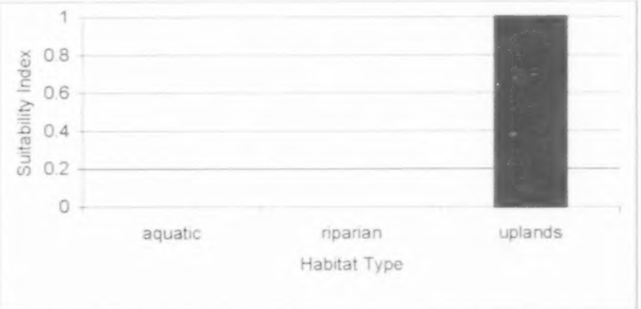


Figure 10.5 Habitat type suitability index for the olive-backed pocket mouse

7.0 HSI EQUATION

$$\mathbf{HSI = (2*V_1+V_2+V_3+V_4)/5*V_5}$$

Olive-backed pocket mice occur only in upland habitat. Consequently, habitat type (V_5) is the main factor limiting potential habitat for this species. Within upland habitat, pocket mice require soil textures (V_1) that allow them to construct underground burrows in which to live and to hibernate during the winter. In areas suitable for burrow construction, the percentage of barren ground (V_2), graminoids (V_3) and shrubs (V_4) should influence habitat use by this species due to their influence on movement and foraging.

8.0 HABITAT SUITABILITY MAP

There was no map produced for the olive-backed pocket mouse due to the lack of data for one of the digital layers required by the model. If the data becomes available then a map will be produced highlighting suitable habitat for the mouse in the Milk River Basin.

9.0 LITERATURE CITED

Alberta Sustainable Resource Development. 2001. The General Status of Alberta Wild Species 2000. Alberta Sustainable Resource Development, Fish and Wildlife Service, Edmonton, AB. 46 pp. Publ. No. I/023.

Gummer, D.L. and S.E. Robertson. 2003. Distribution of Ord's kangaroo rats in southeastern Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Report No. 63. Edmonton, AB.

Manning, R. W. and J. K. Jones Jr. 1988. *Perognathuis fasciatus*. American Society of Mammalogists. Mammalian Species 303. 4 pp.

Prefaur, J. E. and R. S. Hoffmann. 1975. Studies of small mammal populations at three sites on the Northern Great Plains. Occas. Papers Mus. Nat. Hist. Univ. Kansas. 37: 1-27.

Reynolds, H. W., Barry, S. J. and H. P. L. Kiliaan. 1999. Small mammal component report, Canadian Forces Base Suffield National Wildlife Area Wildlife Inventory. Canadian Wildlife Service. Edmonton, AB. 140 pp.

Smith, H. C. 1993. Alberta mammals, an atlas and guide. Provincial Museum of Alberta. Edmonton, AB. 238 pp.

Richardson's Ground Squirrel *(Spermophilus richardsonii)*

Brad A. Downey
Alberta Conservation Association, Lethbridge, AB

1.0 PURPOSE AND LIMITATIONS

The purpose of this model is to indicate potential habitat for the Richardson's ground squirrel (*Spermophilus richardsonii*) within the Milk River Basin. As this is a landscape level model with coarse variables, it may not be directly applicable to other areas or for site-specific analysis.

2.0 GENERAL INFORMATION

The Richardson's ground squirrel is currently classified as "Secure" in Alberta (Alberta Sustainable Resource Development 2001). Ground squirrels, once the most abundant terrestrial mammal (Reynolds et al. 1999), are widespread across the prairies and play an essential role in the biodiversity of the prairie ecosystem, particularly as prey species and by providing underground refuges for native prairie species (Michener and Schmutz 2002). Richardson's ground squirrels are medium-sized rodents that weigh 250-550g, depending on sex and time of year. The Richardson's ground squirrel is sandy brown or buffy yellow in colour with darker hairs on its back giving it a mottled appearance. It has small round ears, a furred tail tinged with black, and large eyes placed high on its head (Smith 1993). Richardson's ground squirrels are diurnal but spend only 15% of their life above ground. Ground squirrels are usually seen above ground 75 minutes after sunrise to 75 minutes before sunset (Michener and Schmutz 2002).

3.0 GENERAL HABITAT ASSOCIATIONS

3.1 Food

Richardson's ground squirrels are mostly herbivores, with vegetation (leaves, flowers, and seeds) accounting for 80-100% of their total diet. In agriculturally dominated areas they consume the seeds and seedlings of wheat, barley, and oats (Michener and Schmutz 2002). A higher abundance of ground squirrels and larger young are usually found in these agriculturally dominated areas. They also consume insects, and on rare occasions eat easily obtained meat such as road kills (Michener and Schmutz 2002).

3.2 Cover

Richardson's ground squirrels are opportunistic and occur not only in their natural prairie habitat but also in native pastures, tame pastures, cultivated fields, hay land, parkland, parks, farmyards, and ditches. They are found in the highest numbers in flat heavily grazed areas and in smaller numbers in taller vegetation (Michener and Schmutz 2002). Ground squirrels can persist on islands of grassland or along ditches surrounded by cultivation (Michener 2000). A key-limiting factor to their habitat requirements may be the type of soil in which they construct their burrows. They usually do not inhabit sandy or clay soils in which tunnels are prone to collapse (Reynolds et al. 1999). In the locations where they are in sandy soil, Reynolds et al. (1999) found them to be along roadways where the compaction of the area during road construction caused the soil to be stable enough for the excavation of burrows. Ground squirrels can also sometimes be found in sandy well-vegetated soils where the vegetation's roots hold the soil together.

4.0 HABITAT AREA REQUIREMENTS

An adult female ground squirrel maintains a home range of up to 240m² in the summer. Home ranges of females often overlap with those of their close female relatives such as sisters or daughters (Michener 2000). Home range for males varies throughout the year. During the breeding season the male's home range can overlap the areas used by as many as 10 females, however after the breeding season males are restricted to small areas by the aggression of pregnant and lactating females (Michener 2000).

5.0 ASSOCIATED SPECIES

Smith (1993) and Michener (1996, 2000) identify Richardson's ground squirrels as a vital prey source for ferruginous hawk (*Buteo regalis*), Swainson's hawk (*Buteo swainsoni*), prairie falcon (*Falco mexicanus*), prairie rattlesnake (*Crotalus viridis*), American badger (*Taxidea taxus*), and long-tailed weasel (*Mustela frenata*). Their burrows also provide refuge and shelter for burrowing owls (*Athene cunicularia*), bumblebees, several species of snakes, and small mammals (Michener and Schmutz 2002).

6.0 THE HSI MODEL

6.1 Selected Habitat Variables

6.1.1 Graminoid Coverage (V_1)

Richardson's ground squirrels prefer short grass native prairie/pasture but can also occupy small isolated islands within cropland (Michener 1996). The threshold set at 20% graminoid coverage accounts for these small areas of grassland within cropland (Figure 11.1).

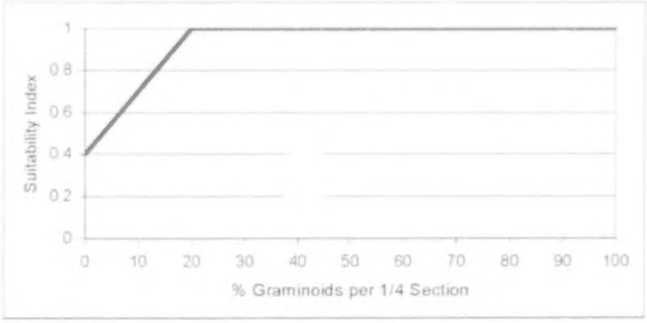


Figure 11.1 Graminoid coverage habitat suitability index for the Richardson's ground squirrel

6.1.2 Slope (V_2)

Reynolds et al. (1999) found most of their ground squirrel observations to be within flat uplands where they could survey long distances for predators (Figure 11.2). Richardson's ground squirrels prefer flat, open habitat and would probably not be found in ¼ sections with slopes greater than 25 degrees (G.Michener, pers. comm.).

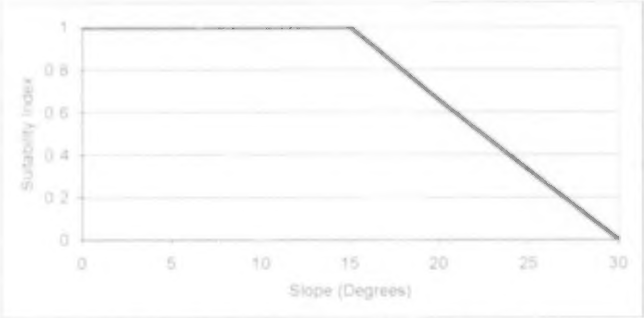


Figure 11.2 Slope habitat suitability index for the Richardson's ground squirrel

6.1.3 Soil Texture (V_3)

Soil textures were grouped into one of five categories as separated by Brady and Weil (1999) (Table 11.1). Richardson's ground squirrels were usually found not to inhabit areas with loose sand or heavy clays (Reynolds et al. 1999), which correspond to coarse and fine textured soils (Figure 11.3).

Table 11.1 Soil texture classifications

Soil Texture Classification	Symbol	Soil Textures Included
Coarse	C	Sands, Loamy sands
Moderately Coarse	MC	Sandy loam
Medium	M	Loam, Silt loam, Silt
Moderately Fine	MF	Sandy clay loam, Silty clay loam, Clay loam
Fine	F	Sandy clay, Silty clay, Clay

[1] U.S. Department of Agriculture Classification System adapted from Brady and Weil (1999)

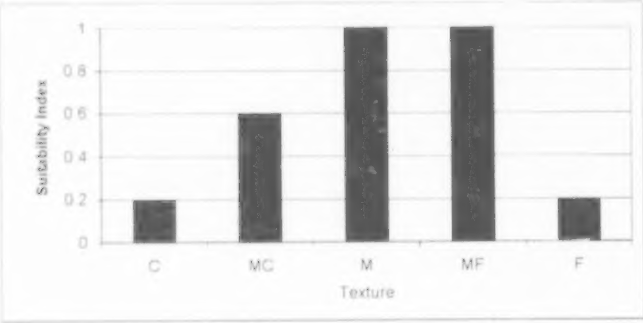


Figure 11.3 Soil Texture habitat suitability index for the Richardson's ground squirrel

6.1.4 Shrub and Tree Coverage

Richardson's ground squirrels prefer open prairies and will select against heavily forested areas (Figure 11.4).

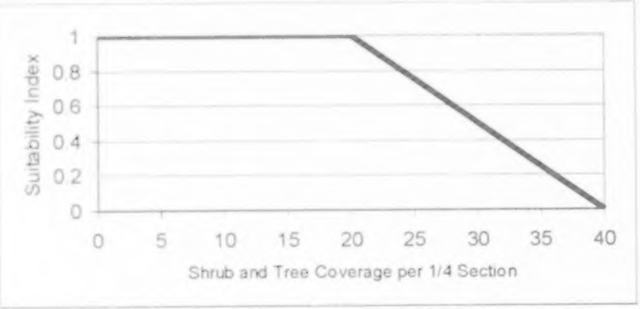


Figure 11.4 Shrub and tree coverage habitat suitability index for the Richardson's ground squirrel

7.0 HSI EQUATION

$$HSI = V_1*V_2*V_3*V_4$$

Graminoid coverage (V_1), slope (V_2), soil texture (V_3), and shrub/tree coverage are considered equal and non-compensatory so the absence or negative effects of one variable will decrease or eliminate the possibility of ground squirrels occurring on certain ¼ sections. An abundance of shrubs/trees will decrease visibility of predators and in turn harbour more predators. Soil texture can reduce the HSI value of ¼ sections due to the ground squirrel's inability to construct appropriate burrows. Slope can severely impact the HSI value of ¼ sections by limiting the ground squirrel's vision and decreasing their ability of seeing predators. Lack of graminoids can reduce the HSI value of ¼ sections by limiting their forage base, however, if no graminoids are present the HSI value for the ¼ section is still given a .4 value because ground squirrels will also consume cereal crops.

8.0 HABITAT SUITABILITY MAP

Please refer to Appendix J for a colour map that portrays potential habitat for the Richardson's ground squirrel in the Milk River Basin. Large continuous areas of suitable habitat and burrow construction are available for the Richardson's ground squirrel in the eastern and western areas of the basin. The central areas of the basin were not found to be suitable due to the increased amount of cultivation, which significantly decreases habitat suitability for this species.

9.0 LITERATURE CITED

Alberta Sustainable Resource Development. 2001. The general status of Alberta wild species 2000. Alberta Sustainable Resource Development, Fish and Wildlife Service, Edmonton, AB. 46 pp. Publ. No. I/023.

Brady, N.C. and R.R. Weil. 1999. The Nature and Properties of Soils- Twelfth edition. Prentice Hall Inc. Upper Saddle River, New Jersey, U.S.A. 881 pp.

Michener, G.R. 1996. Establishment of a colony of Richardson's ground squirrels in southern Alberta. Pp. 303-308 In: Proceedings of the fourth prairie conservation and endangered species workshop. Edited by W.D. Willms and J.F.Dormaar. Provincial Museum of Alberta. Natural History Occasional Paper 23: 1-337.

Michener, G.R. 2002. Richardson's ground squirrel *(Spermophilus richadsonii)*. University of Lethbridge Online Paper (http://home.uleth.ca/~michener)

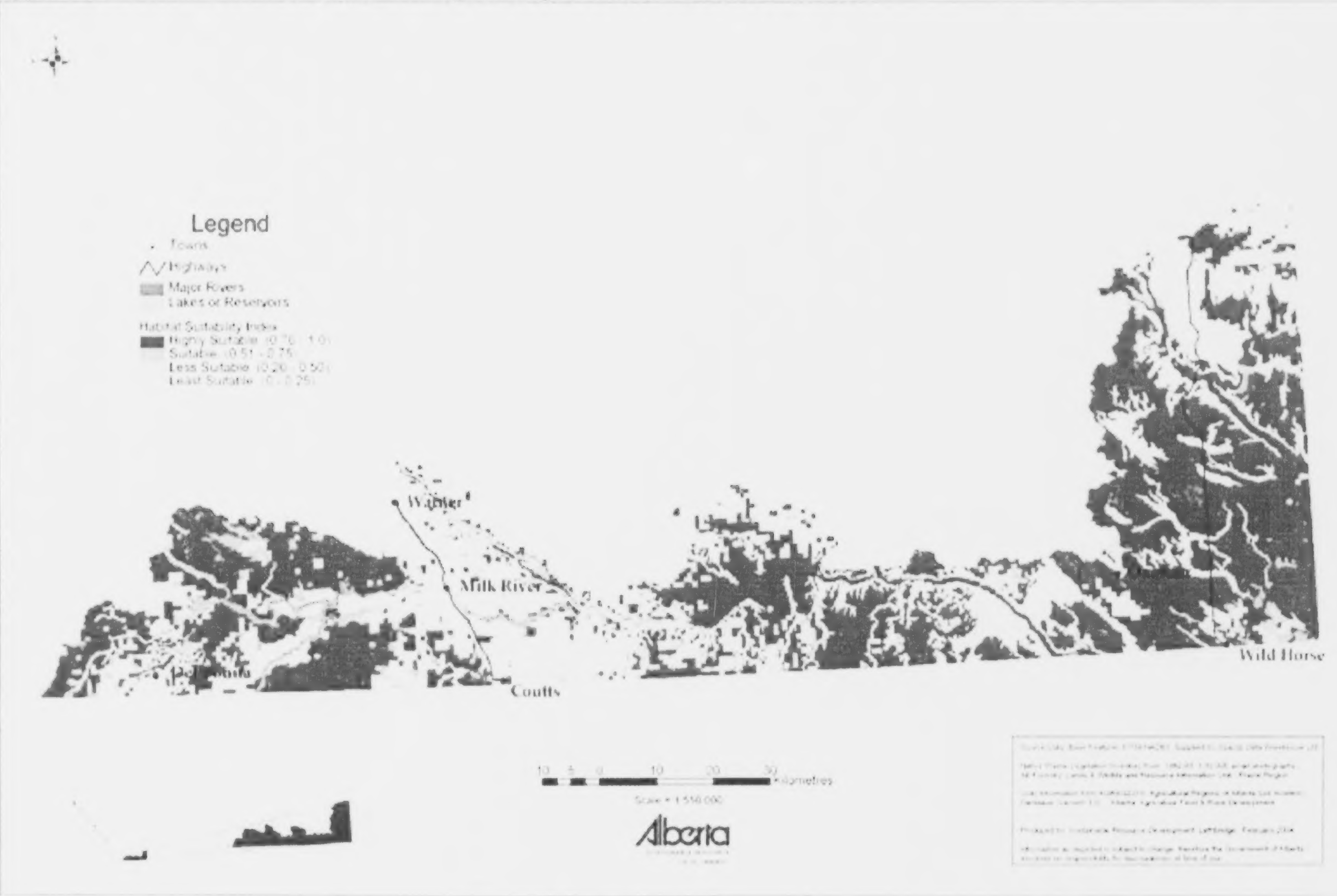
Michener, G.R. and J.K. Schmutz. 2002. Richardson's ground squirrel -*Spermophilus richardsonii*. Alberta Prairie Conservation Forum- Prairie Notes Online Paper (http://www.albertapcf.ab.ca/prairienotes.htm)

Michener, G.R. and Koeppl, J.W. 1985. *Spermophilus richardsonii*. Mammalian Species 243: 1-8.

Reynolds, H.W., S.J. Barry, and H.P.L. Kiliaan. 1999. Small mammal component report: Canadian Forces Base Suffield National Wildlife Area. Canadian Wildlife Service, Edmonton, AB. 140 pp.

Smith, H.C.1993. Alberta Mammals -An Atlas and Guide. The Provincial Museum of Alberta. Edmonton, AB. 23.

Appendix J - Potential habitat for Richardson's ground squirrel within the Milk River Basin


Legend
Towns
Highways
Major Rivers
Lakes or Reservoirs
Habitat Suitability Index
Highly Suitable (0.76 - 1.0)
Suitable (0.51 - 0.75)
Less Suitable (0.26 - 0.50)
Least Suitable (0 - 0.25)
Warner
Milk River
Coutts
Wild Horse
10 5 0 10 20 30
Kilometres

Swift Fox *(Vulpes velox)*

Brad A. Downey
Alberta Conservation Association, Lethbridge, Alberta

1.0 PURPOSE AND LIMITATIONS

The purpose of this model is to indicate potential habitat for swift fox *(Vulpes velox)* within the Milk River Basin. As this is a landscape level model with coarse variables, it may not be directly applicable to other areas or for site-specific analysis.

2.0 GENERAL INFORMATION

The swift fox is the smallest member of the Canid family (Cotterill 1997) with a total length of 840 mm and weighing between 2 and 3 kg. Historically their range stretched across the Canadian Prairies and south to Texas in the U.S.A (Carbyn 1998). They can be identified from young coyotes by the black tip on their tail and black around their muzzle. In the winter they appear buffy grey with red coloration in the abdominal areas (Carbyn 2000). The swift fox, as the name suggest, can reach speeds up to 60km/hr, however their speed didn't prevent them from becoming "Extirpated" from Canada by the late 1930's (Moehrenschlager and Moehrenschlager 2001).

The swift fox was reintroduced into the Canadian wild in 1983 after a ten-year captive breeding project, which began with the Smeeton family who established what is know known as the Wildlife Reserve of Western Canada near Cochrane, Alberta (Reynolds 1987). Numerous agencies and universities were involved with the project; a few of them are the Canadian Wildlife Service, World Wildlife Fund (Canada), Alberta Recreation Parks and Wildlife Foundation, Alberta Fish and Wildlife Service, Saskatchewan Department of Environment and Resource Management, Grasslands National Park, Esso Resources Canada Limited, and the University of Calgary. Captive breeding programs were ran at the Calgary Zoo, Edmonton Zoo, and Moose Jaw Zoo, and wild foxes were captured for release and breeding from Wyoming, South Dakota, and Colorado. Swift foxes are currently classified as "Endangered" in Alberta and were down listed from "Extirpated" to "Endangered" by COSEWIC on April 1998 due to the re-establishment of populations in Alberta and Saskatchewan (Alberta Sustainable Resource Development 2001; COSEWIC 2000). The most recent population estimates conducted in 2000 placed the Alberta/Saskatchewan border population of swift foxes at 560 individuals, up from the population estimate of 192 in 1996-1997 (Moehrenschlager and Moehrenschlager 2001).

3.0 HABITAT ASSOCIATIONS

3.2 Food

The swift fox is primarily a nocturnal hunter, which feeds opportunistically on smaller mammals, carrion, invertebrates (grasshoppers and beetles), vegetation, small birds, fish, reptiles, and amphibians (Carbyn et al. 1994 in Cotterill 1997). In Alberta their primary prey are small rodents, followed by dead ungulates, lagomorphs, and ground squirrels (Reynolds et al. 1991 in Cotterill 1997). Their food preference can change depending on the season and abundance of prey. In the winter swift foxes become more reliant on microtines, rabbits, birds, and carrion (Scott-Brown et al. 1986).

3.1 Cover

Swift foxes prefer short or mixed grass unfragmented prairies that are predominately flat with sparse vegetation that allows them easy mobility and high visibility when it comes to eluding and detecting predators (Carbyn 1998). Forest, coulees, steep slopes, broad agricultural areas, and dense shrubs are usually avoided and can cause barriers between populations (Carbyn 1995; Whitaker-Hoagland 1997 in Carbyn 2000). Native prairie is selected over cultivation in Canada and the northern United States, which partially explains the decline and subsequent demise of the species in Alberta; currently only 46% of their historical range remains as original habitat (Carbyn 1998). Semi- fossorial mammals such as American badgers (*Taxus taxus*) are key in providing swift foxes with numerous holes in which to elude predators or develop into a den. Permanent water bodies, lagomorphs, and rodents can enhance swift fox habitat however numerous predators or rodent control programs would be detrimental (Brechtel et al. 1996; Mamo 1994)

4.0 HABITAT AREA REQUIREMENTS

Home ranges of swift foxes are similar between states and provinces. In Alberta their home range is approximately 34.1 km^2 compared to Nebraska at 32.3 km^2 (Hines and Case 1991) and Colorado at 20-30 km^2 (Rongstad et al. 1990 in Cotterill 1997). Swift foxes are also non-territorial with home ranges overlapping in high quality habitat (Carbyn et al. 1994 in Cotterill 1997).

5.0 ASSOCIATED SPECIES

The swift fox is reliant on other semi-fossorial mammals like the American badger (*Taxus taxus*) and Richardson's ground squirrel (*Spermophilus richardsonii*) for escape burrows and den sites (Carbyn 1998). However the badger also present itself as a predator of swift foxes along with coyotes (*Canis latrans*) and golden eagles (*Aquila chrysaetos*). Burrowing owls (*Athene cunicularia*) use badger, ground squirrel, or old fox dens as well for their nest. Red foxes (*Vulpes vulpes*) can be found in similar habitat and may compete with swift foxes for suitable prey and denning locations. High abundance of red foxes would be detrimental for swift foxes due to territoriality. Marbled godwit (*Limosa fedoa*), willets (*Catoptrophorus semipalmatus*), sharp-tailed grouse (*Tympanuchus phasianellus*), and Nuttall's cottontail (*Sylvilagus nuttallii*) are a few of the species that swift fox prey on (Scott-Brown et al. 1986).

Long-billed curlews (*Numenius americanus*), Sprague's pipits (*Antus spragueii*), and ferruginous hawks (*Buteo regalis*) can also be found in similar habitat

6.0 HSI MODELS

6.1 Selected Habitat Variables

6.1.1 Shrubs (V_1)

The swift fox is typically found in open flat prairies. Numerous shrubs would limit visibility as well as provide nesting habitat or cover for species that would predate on swift foxes (Figure 12.1). However a few scattered shrubs would provide habitat and cover for prey such as birds, microtines, or lagomorphs, which are important in the winter.

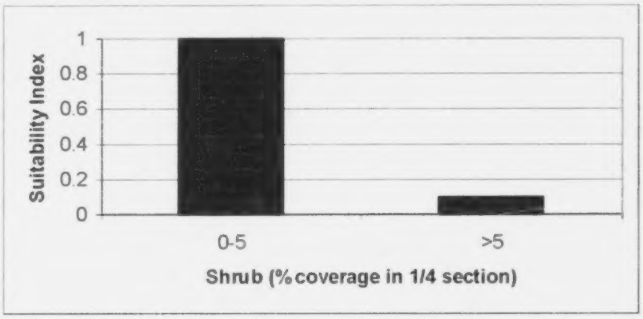


Figure 12.1 Shrub coverage habitat suitability index for the swift fox.

6.1.2 Slope (V_2)

Steep inclines are impassable for swift foxes and can present barriers for movement between suitable habitats. Extensive breaks (rough terrain) may pose potential barriers along river systems. Swift fox prefer flat to rolling terrain (Carbyn 2000). Flat ground, ≤ 15 degrees, would be considered suitable swift fox habitat (Figure 12.2). Slope variables were selected based on the coarse nature of the data layer available for mapping. A slope of 30 degrees highlighted by the data layer represents ~75 degree slopes on the ground.

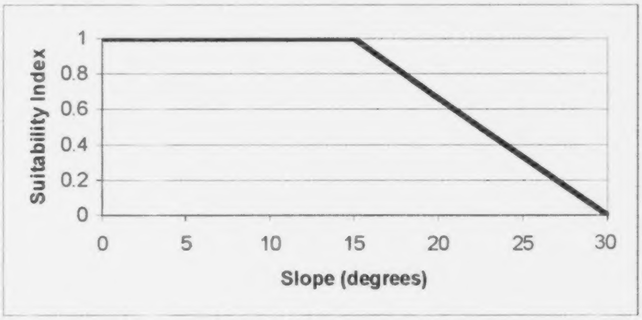


Figure 12.2 Habitat suitability index for degrees slope for the swift fox.

6.1.3 Graminoids (V_3)

Swift foxes are predominately found on open native prairie and tend to avoid cultivation. Quarter sections containing 75-100% grassland are given a suitability of one, while the sections containing less then 75 % are given lower values relating to the decrease in percent grassland (Figure 12.3). Out of 252 sightings within BSOD along the Alberta/Saskatchewan border 227 (90%) were in 75-100% graminoid coverage. A decrease in the amount of graminoids in a quarter section is a result of increases in cultivation, urbanization, or tree/shrub cover, all of which are detrimental to swift fox habitat.

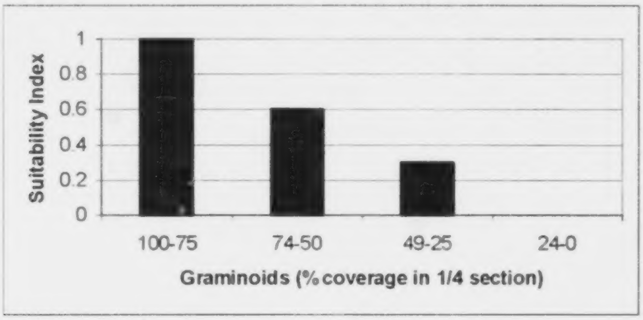


Figure 12.3 Native prairie graminoid coverage habitat suitability index for the swift fox.

6.1.4 Soil Structure (V_4)

Swift foxes require habitat with friable soil in which other semi-fossorial mammals like American badgers and Richardson's ground squirrels construct their burrows. Low HSI values are assigned to coarse textured soils (sand) (Table 12.1), which are prone to collapsing and fine textured soils (clay), which are prone to flooding (Figure 12.4).

Table 12.1 Soil texture classifications

Soil Texture Classification	Symbol	Soil Textures Included
Coarse	C	Sands, Loamy sands
Moderately Coarse	MC	Sandy loam
Medium	M	Loam, Silt loam, Silt
Moderately Fine	MF	Sandy clay loam, Silty clay loam, Clay loam
Fine	F	Sandy clay, Silty clay, Clay

[3] U.S. Department of Agriculture Classification System adapted from Brady and Weil (1999)

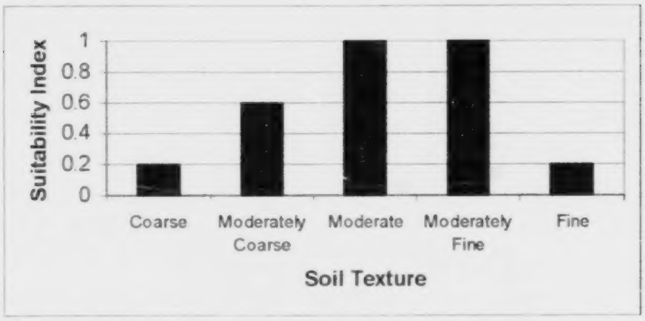


Figure 12.4 Soil texture habitat suitability index for the swift fox.

7.0 HSI EQUATION

$$HSI=(V_1*V_2*V_3*V_4)$$

The equation takes into consideration that the four variables are non-compensatory meaning that lower values of one variable will not be compensated by higher values of another. The equation will indicate potential swift fox habitat focusing on suitable den locations, which consists of flat ground with abundant grassland, a low abundance of shrubs, and situated on suitable soil for denning. Areas with steep slopes, cultivation, numerous shrubs, or poor soil textures will be excluded.

8.0 OTHER VARIABLES CONSIDERED

8.1 Grazing Pressure

Over grazing can reduce prey diversity and may reduce swift fox habitat (Brecthel 1994). Swift fox prefer areas of sparse and short vegetation (25cm or less; Carbyn 2000).

8.2 Prey abundance

Areas with high prey abundance can provide adequate resources for both swift foxes and coyotes however as prey abundance decreases the amount of inter-specific killings of swift foxes by coyotes will increase (Palomares 1999).

8.3 Predator Abundance

The number of coyotes in a given area will significantly impact the suitability for swift fox habitat, as they are a major competitor and predator of swift fox (Brecthel 1994). Studies conducted in North-western Texas found that swift fox territories occurred near the periphery and just outside core areas of the coyote's home ranges and any swift foxes that set up dens within the core area were subsequently killed within 4-9weeks (Kamler 2003). Resident coyote populations can be responsible for limiting the available habitat and carrying capacity of swift fox populations (Kamler 2003). Unfortunately coyote abundance was too difficult to map at this time.

8.0 HABITAT SUITABILITY MAP

Please refer to Appendix K for a colour map depicting suitable habitat for the swift fox in the Milk River Basin. This map is based on the habitat variables used in the habitat suitability model equation; soil texture, shrub coverage, native graminoid coverage and slope. These variables indicate suitable habitat for the swift fox in the eastern and far western areas of the basin. There is limited habitat in the central areas of the basin due to the increased agricultural activity.

Several other habitat variables were identified as important for the swift fox, these include predator abundance, prey abundance and grazing pressure, however they are not available in a digital form at this time. If they become available they will be used to refine the habitat suitability model.

The Swift fox Recovery team has also developed a HSI model for the swift fox however it was not available at the time the Milk River Basin model was developed. Similar areas are highlighted in both models for the Milk River. It is suggested that the Milk River Basin model be looked at in conjunction with the Swift fox teams model which is built on more refined data and is able to weed out smaller patch sizes.

8.0 LITERATURE CITED

Alberta Sustainable Resource Development. 2001. The general status of Alberta wild species 2000. Alberta Sustainable Resource Development, Fish and Wildlife Service, Edmonton, AB. 46 pp. Publ. No. I/023.

Brady, N.C. and R.R. Weil. 1999. The Nature and Properties of Soils- Twelfth edition. Prentice Hall Inc. Upper Saddle River, New Jersey, U.S.A. 881 pp.

Brechtel, S., L. Carbyn, G. Erickson, D. Hjertaas, C. Mamo, and P. McDougall. 1996. National recovery plan for the Swift Fox. Report No.15. Recovery of Nationally Endangered Wildlife Committee, Ottawa, ON. 29 pp.

Carbyn, L.N. 1998. Update COSEWIC status report on the swift fox Vulpes velox in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-44 pp.

COSEWIC 2000. COSEWIC assessment and update status report on the swift fox Vulpes velox in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. Vi + 44pp.

Cotterill, S.E. 1997. Status of the Swift Fox (*Vulpes velox*) in Alberta. Alberta Environmental Protection, Wildlife Management Division, Wildlife Status Report No. 7, Edmonton, AB. 17 pp.

Kamler, J.F., W.B. Ballard, R.L. Gilliland, and K. Mote. 2003. Spatial relationships between swift foxes and coyotes in northwestern Texas. Can. J. Zool. 81: 168-172

Mamo, C. 1994. Swift Fox habitat survey. Unpubl. Report for Alberta Fish and Wildlife, Edmonton, AB. 25 pp.

Moehrenschlager, A. and C. Moehrenschlager. 2001. Census of Swift Fox (Vulpes velox) in Canada and Northern Montana: 2000-2001. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Report No. 24. Edmonton, AB. 21 pp.

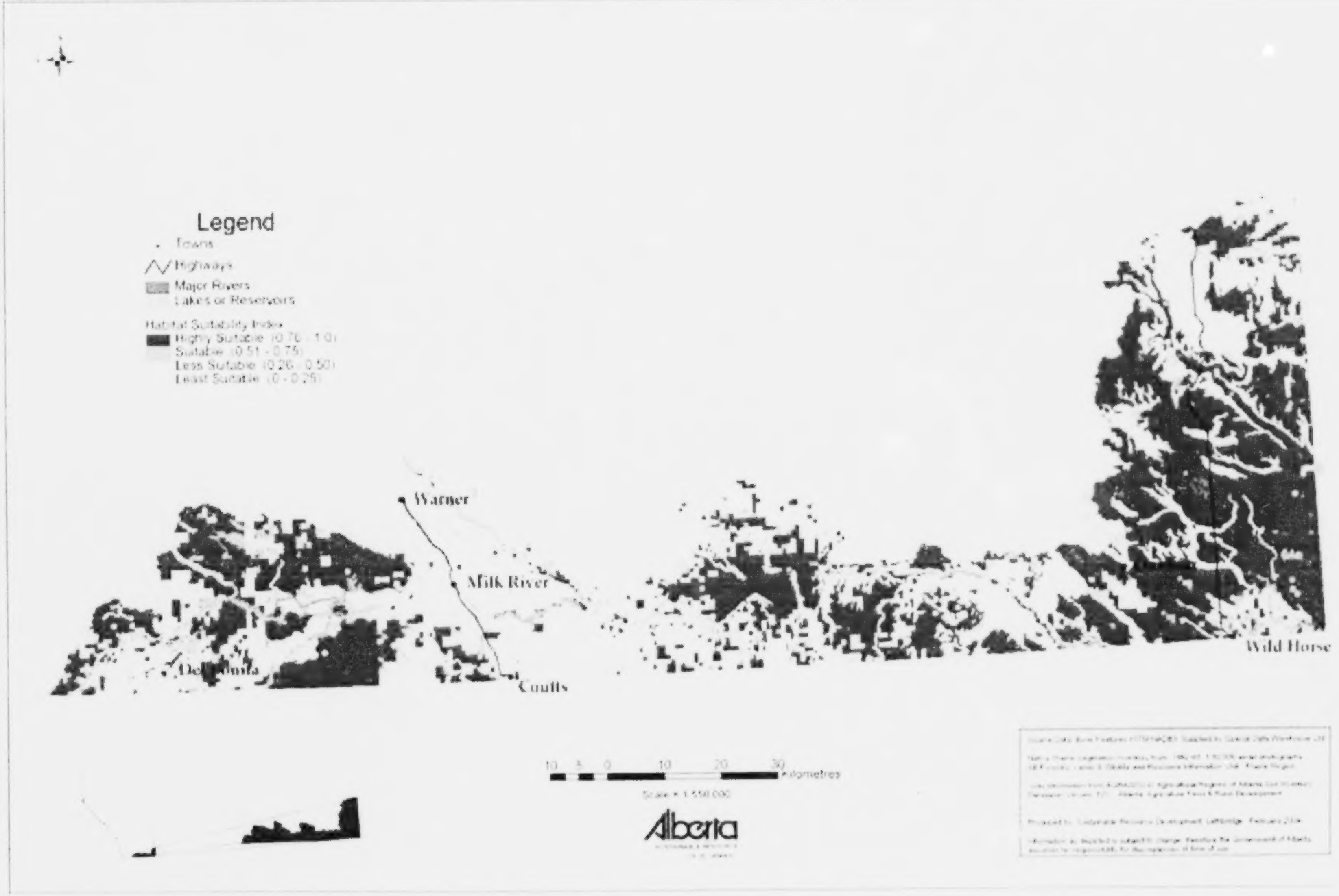
Palomares, F., and T.M. Caro. 1999. Inter-specific killing among mammalian carnivores. Am. Nat. 153: 492-508

Reynolds, J. 1987. Swift fox reintroduction project. Pp. 291-292 in Proceedings of the workshop on endangered species in the prairie provinces (G.L. Holroyd, W.B. McGillivray, P.H.R. Stepney, D. M. Ealey, G. C. Trottier, K. E. Eberhart, eds.). Prov. Mus. Alberta Nat. Hist. Occ. Paper No. 9, Edmonton, AB. 367 pp.

Scott-Brown, J.M., S. Herrero, and C. Mamo. 1986. Monitoring of released Swift Fox in Alberta and Saskatchewan- Final report 1986. Unpubl. Report for Canadian Wildlife Service, Edmonton, AB. 97 pp.

Whitetaker-Hoagland, J. 1997. A review of literature related to swift fox habitat use. Swift fox conservation team annual report B. Gidding editor. P 113-125.

Appendix K - Potential habitat for swift fox within the Milk River Basin


Legend
Towns
Highways
Major Rivers
Lakes or Reservoirs
Habitat Suitability Index
Highly Suitable (0.76 - 1.0)
Suitable (0.51 - 0.75)
Less Suitable (0.26 - 0.50)
Least Suitable (0 - 0.25)
Warner
Milk River
Coutts
Del Bonita
Wild Horse
10 5 0 10 20 30 Kilometres
Scale = 1:550,000
Alberta

Western Small-footed Myotis (*Myotis ciliolabrum ciliolabrum*)

Julie P. Landry
Alberta Conservation Association, Lethbridge, AB

1.0 PURPOSE AND LIMITATIONS

The purpose of this model is to indicate potential habitat for Western small-footed myotis (*Myotis ciliolabrum ciliolabrum*) within the Milk River Basin. As this is a landscape level model with coarse variables, it may not be directly applicable to other areas or for site-specific analysis.

2.0 GENERAL INFORMATION

Myotis ciliolabrum has recently been considered a distinct species (Herd 1987). Confusion may arise when looking at historical data because *Myotis ciliolabrum* may have been referred to incorrectly by names such as the Least brown bat, *Myotis subulatus*, *Myotis leibii* (which is the Eastern small-footed myotis), and *Myotis leibii ciliolabrum*. Western small-footed bats can be found in many parts of western North America, from southern British Columbia, Alberta, and Saskatchewan (Nagorsen and Brigham 1993, Pybus 1986) and southward to Mexico (Nagorsen and Brigham 1993). The western small-footed myotis consists of two sub-species, the *M.c. melanorhinus* found in British Columbia and the *M.c. ciliolabrum* whose distribution is limited to Alberta and Saskatchewan (van Zyll de Jong 1985).

In Alberta, this bat has been found along the Red Deer River (Schowalter and Dorward 1978) and southward along the South Saskatchewan and Oldman Rivers (Engley and Norton 2001). Its western and northern extents stretch to Lethbridge and Rumsey, respectively (Smith 1993). The western small-footed myotis is also thought to be widespread in the badlands and semi-arid river valleys of the Milk River area (Pybus 1986).

The western small-footed myotis is Alberta's smallest bat (Engley and Norton 2001, Nagorsen and Brigham 1993) and is an inhabitant of the grassland natural region (Engley and Norton 2001, Smith 1993). Currently, The General Status of Alberta Wild Species (Alberta Sustainable Resource Development 2001) considers the western small-footed myotis a "Sensitive" species. Under the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2001) the western small-footed myotis is not ranked.

The western small-footed bat has fur that varies in colour from pale tan to orange-yellow (Nagorsen and Brigham 1993) or from pale yellow-brown to flaxen (van Zyll de Jong 1995) on its back, with a contrasting lighter underside (Nagorsen and Brigham 1993). It has medium length black ears and a dark facial band through its eyes (Smith 1982, Arizona Game and Fish Department 1997), as well as a black nose and black flight membranes (Smith 1993, Garcia et al. 1995). It has a keeled calcar (Smith 1982, Nagorsen and Brigham 1993, Arizona Game and Fish Department 1997, Smith 1993), a long and narrow tragus, and small feet (Nagorsen and Brigham 1993) which are less than half as long as its tibia (van Zyll de Jong 1985). The western small-footed myotis has a very small and delicate skull with a gradually sloping forehead (Nagorsen and Brigham 1993, Arizona Game and Fish Department 1997, Smith 1993), and has relatively small teeth (Smith 1993).

Mating is assumed to take place before hibernation begins (Nagorsen and Brigham 1993) and it is thought that females store sperm until spring (Garcia et al. 1995). Like all myotis', the western small-footed myotis has only one litter per year (Arizona Game and Fish Department 1997), with one offspring weighing about 1 gram being born during the period of mid-June to mid-July (Nagorsen and Brigham 1993). There is some evidence that this bat may give birth to twins (Nagorsen and Brigham 1993).

3.0 GENERAL HABITAT ASSOCIATIONS

3.1 Food

The western small-footed myotis' diet consists of invertebrates, and foraging generally occurs in flight (Schowalter and Allen 1981). In the Okanagan valley of British Columbia, its diet consists primarily of caddisflies, but they will also eat flies, beetles, and moths (Nagorsen and Brigham 1993). In southeastern Alberta, Holloway and Barclay (2000) found flies (dipterans) to be the most frequently preyed upon.

Western small-footed myotis foraging activity is related to the distribution of insects, which is largely concentrated along rivers and springs (Holloway and Barclay 2000). Bat foraging activity also seems to increase in treed riparian areas; particularly where there are riparian cottonwoods because they may provide shelter, food, and substrate for reproduction for the invertebrates (Holloway and Barclay 2000). Foraging has been documented along cliffs, talus slopes, steep banks, and rocky outcrops (Nagorsen and Brigham 1993). Holloway and Barclay (2000) found almost no feeding activity along areas of low-slope topography. Foraging usually occurs within 1-2 km of their roosting habitat (Holloway 1998, as cited in Holloway and Barclay 2000, Lausen 2002, pers. comm.).

3.2 Water

Water systems such as rivers and springs are used for drinking as well as foraging (Holloway and Barclay 2000). Many of the invertebrates the western small-footed myotis preys upon require water at various life cycle stages (Borror and Delong 1971, as cited in Holloway and Barclay 2000), resulting in a connection between the western small-footed myotis and water bodies. Holloway and Barclay (2000) found a decrease in bat activity as distance from water increased and found no bats more than 1 km away from a water source. In hot and dry areas, water availability may be a limiting factor in bat abundance (Chung-MacCoubrey 1996, as cited in Holloway and Barclay 2000).

3.3 Cover

In Canada, inhabited areas include arid, short-grass prairies with steep riverbanks and clay buttes (van Zyll de Jong 1985). In southeastern Alberta, arid river valleys

(Schowalter 1979) with cliff and rock outcrops are the preferred roosting habitat of western small-footed bats (Nagorsen and Brigham 1993, Smith 1986).

3.4 Roosting Habitat

Areas for roosting are likely the most limiting factor for this bat. Unlike various other bats, this myotis does not roost in trees, but rather under rocks, (Nagorsen and Brigham 1993) and in holes and crevices found in rock outcrops within cliffs and coulees (Holloway and Barclay 2000). Summer roosts can be found in cavities within cliffs, boulders, vertical banks, the ground, and talus slopes (Nagorsen and Brigham 1993). Preferred roosting sites are in small, protected, and dry and hot (27-33°C) crevices (Nagorsen and Brigham 1993). Although human disturbance may be of limited concern for the western small-footed myotis, activities such as the damming of rivers may flood their roosting habitat (Lausen, pers.comm.).

The western small-footed myotis has been found roosting within the Little Rocky Mountains of north central Montana (Hendricks et al. 2000). The Little Rocky Mountains' core is tertiary igneous syenite jutting out through beds of Cambrian and Devonian limestone and sandstone (Alt and Hyndmann 1986, as cited in Hendricks et al. 2000). In comparison, roosting areas may be found in eroded mudstone and sandstone within the Milk River valley (Lausen 2002, pers. comm.).

3.4.1 Day Roosts

Day roosts can be found in unvegetated areas in eroded mudstone holes, under rocks, and in crevices (Lausen 2002, pers. comm.). Switching of roosts occurs daily, and roost home range of an individual is small (probably less than 200 m between all roosts) (Lausen 2002, pers. comm.).

3.4.2 Night Roosts

Myotis c. ciliolabrum tend to roost in larger groups at night, and roosts are likely to be found in larger holes such as caves (Lausen 2002, pers. comm.) and possibly abandoned mines (Nagorsen and Brigham 1993). Night roosts are usually closer to foraging areas than day roosts, and night roosts may also be relatively warmer than their day roosts, which tend to cool off at night (Barclay 2002, pers. comm.).

3.4.3 Nursery Colonies

Nursery colonies can be found in similar areas as night roosts (Barclay 2002, pers.comm.) including caves, rock face crevices, and in clay banks (Pybus 1986). Nursing colonies are usually small, supporting up to 20 females and their young (Arizona Game and Fish Department 1997).

3.5 Hibernation/Migration

The western small-footed myotis hibernates individually in tight crevices or depressions (Nagorsen and Brigham 1993). There is evidence that this bat hibernates in south central Montana (Pybus 1986) in caves and abandoned mines, preferring temperatures of 1.5-5.5°C (Nagorsen and Brigham 1993). There is also some suggestion that hibernation takes place in British Columbia (Nagorsen and Brigham 1993). Evidence suggesting that the western small-footed myotis hibernates in Alberta is considered deficient; however, there is some speculation that the bat may winter in Dinosaur Provincial Park (Pybus 1986). More research on this species' movements in Alberta is required to determine whether or not it migrates from, or hibernates in, Alberta.

4.0 HABITAT AREA REQUIREMENTS

No literature was found to support a minimum habitat area requirement for the western small-footed bat.

5.0 ASSOCIATED SPECIES

Species that may have similar habitat associations include the prairie falcon (*Falco mexicanus*), little brown bat (*Myotis lucifugus*), golden eagle (*Aquila chrysaetos*) and the prairie rattlesnake (*Crotalus viridis viridis*).

6.0 THE HSI MODEL

6.1 Selected Habitat Variables

6.1.1 Terrain Slope (V_1)

Steep river valley coulees and cliff areas have significantly higher bat activity than areas of more gradual topography (Holloway and Barclay 2000). Steeper terrain areas can be used for foraging (Holloway and Barclay 2000) and may contain rock outcrops for roosting (Smith 1993). Consequently, habitat suitability increases as steepness of terrain increases.

There were limitations in the mapping layers of this variable, and slope could not be portrayed steeper than 40°. In addition, only qualitative descriptions of steep slopes have been mentioned as desirable for the western small-footed myotis. Based on the coarseness of the available data, slopes of ten degrees or more were chosen as the most suitable and assigned an HSI value of 1. Slopes less than 10 degrees received a value of 0.1 (Figure 13.1).

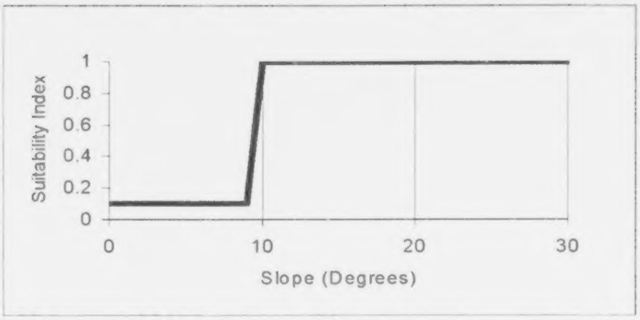


Figure 13.1 Slope habitat suitability index for the western small-footed myotis

6.1.2 Rock Outcrops and Exposed Soil (V_2)

Rock outcrops and exposed mudstone along cliffs and coulees have the potential for containing crevices, holes, and caves which could be used for roosting and nursing habitat. For the purposes of this study, rock outcrops and exposed soil areas are considered preferred roosting habitat. Land descriptions from AGRASID most suited to rock outcrops and exposed soils have been described as badland areas, with soil descriptions ranging from shallow to bedrock. These areas were given a suitability value of 1. All other soil descriptions from AGRASID that were not considered badlands were assigned a value of 0.1, given the possibility that small pockets of suitable habitat may not have been identified (Figure 13.2).

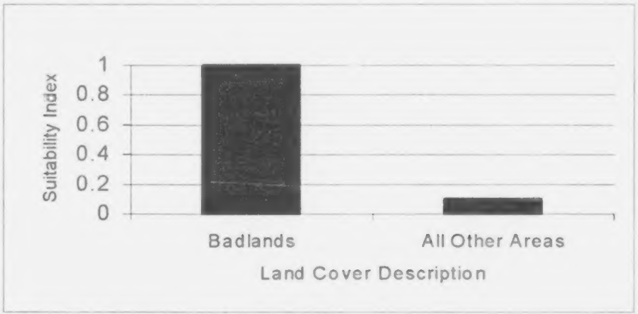


Figure 13.2 Land cover habitat suitability index for the western small-footed myotis

6.1.3 Distance to Water

The western small-footed myotis forages along water bodies. Holloway and Barclay (2000) found that bat activity decreased as distance from water increased. Additionally, on 75% of their research nights, they found that no bats were detected more than 1 km away from a water source. Distances of 0 –1 km from water received the highest HSI value of 1,while distances of 3 km and over were deemed unsuitable and therefore assigned an HSI value of 0 (Figure 13.3).

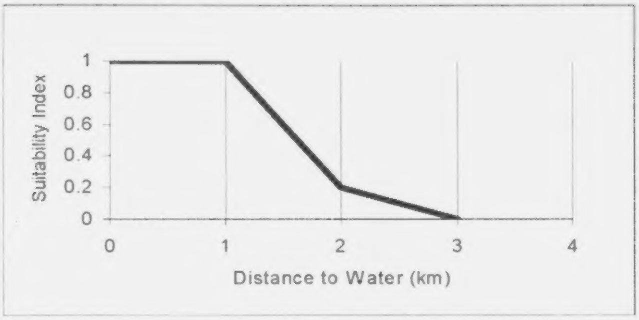


Figure 13.3 Distance to water habitat suitability index for the western small-footed myotis

7.0 HSI EQUATION

$$\text{HSI (Roosting and Foraging)} = V_1 * V_2 * V_3$$

The equation used for the final HSI value considers the 3 variables to be equal and non-compensatory. A low value in one of the variables cannot be compensated by a higher value in another. This equation describes a full interaction between the 3 variables and indicates that the use of foraging areas occurs only when roosting sites are available.

7.1 Other Variables Considered

7.1.1 Presence of Riparian Trees

Bat foraging activity increases in treed (which for the most part are cottonwoods) riparian areas (Holloway and Barclay 2000), however, due to the coarseness of the available data, riparian trees could not be distinguished within riparian areas. If this variable were to become available, it could be added to the formula (as V_4) in a compensatory manner. Because it has not been specified how many trees are required to increase foraging activity, it would be assumed that any presence of riparian trees would increase the amount of foraging and subsequently increase the habitat suitability value.

8.0 HABITAT SUITABILITY MAP

Please refer to Appendix L for a colour map, which identifies suitable habitat for the western small-footed myotis in the Milk River Basin. The map identified several areas where known western small-footed myotis populations exist. In addition to these, a few areas were identified outside the species known range. These areas will require further exploration to test the validity of the model.

9.0 LITERATURE CITED

Alt, D., and D. W. Hyndman. 1986. Roadside geology of Montana. Mountain Press. Missoula, Montana. 427pp.

Alberta Sustainable Resource Development. 2001. The General Status of Alberta Wild Species 2000. Alberta Sustainable Resource Development, Fish and Wildlife Service, Edmonton, AB. 46pp. Publ. No. I/023.

Arizona Game and Fish Department. 1997. *Myotis ciliolabrum*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, AZ. 3 pp.

Borror, D. J. and D. M. Delong. 1971. An introduction to the study of insects. Third edition. Holt, Rinehart and Winston, Austin, Texas.

Chung-MacCoubrey, A. L. 1996. Grassland bats and land management in the Southwest. Pp. 54-63 IN: D.M. Finch (ed.). Ecosystem Disturbance and Wildlife Conservation in Western Grasslands: A Symposium Proceedings. USDA Forest Service, General Technical Report RM-GTR-285. Fort Collins, Colorado.

COSEWIC. 2001. Canadian species at risk, November 2001. Committee on the Status of Endangered Wildlife in Canada. 32 pp.

Engley, L., and M. Norton. 2001. Distribution of selected small mammals in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Service, Alberta Species at Risk Report No. 12. Edmonton, AB. 75 pp.

Garcia, P. F. J., S. A. Rasheed, and S. L. Holroyd. 1995. Status of the western small-footed myotis in British Columbia. Wildlife working report; no. WR-74. ISBN 0-7726- 2690-1. 14 pp.

Hendricks, P., D. L. Genter, and S. Martinez. 2000. Bats of Azure Cave and the Little Rocky Mountains, Montana. The Canadian Field Naturalist 114:89-97.

Herd. R. M. 1987. Electrophoretic divergence of *Myotis leibii* and *Myotis ciliolabrum* (Chiroptera:Vespertilionidae). Canadian Journal of Zoology 65: 1857-1860.

Holloway, G. L. 1998. The ecology of prairie-dwelling bats in southeastern Alberta. M.Sc. thesis, University of Calgary, Calgary, AB.

Holloway, G. L., and R. M. R. Barclay. 2000. Importance of prairie riparian zones to bats in southeastern Alberta. Ecoscience 7(2): 115-122.

Nagorsen, D.W. and R.M. Brigham. 1993. Bats of British Columbia. UBC Press and Royal British Columbia Museum, Vancouver, British Columbia. 164 pp.

Pybus, M. 1986. Bats of Alberta "the real story". Alberta Energy and Natural Resources, Fish and Wildlife Division. Print Media Branch, Alberta Agriculture, Edmonton, AB. 16 pp.

Schowalter, D. B. 1979. Notes on the distribution of bats in Alberta and Saskatchewan. Blue Jay 37: 179-187.

Schowalter, D. B.and A. Allen. 1981. Late summer activity of small-footed, long-eared and big brown bats in Dinosaur Park, Alberta. Blue Jay 39(1): 50-53.

Schowalter, D. B. and W. M. J. Dorward. 1978. Some western Canadian bat records. Blue Jay 36: 49-50.

Smith, H. C. 1982. A key to Alberta bats. Alberta Naturalist 12(3): 115-121.

Smith, H. C. 1986. Mammals of Southeast Alberta. Provincial Museum of Alberta. Natural History Occasional Paper No. 7. 52 pp.

Smith, H. C. 1993. Alberta mammals: an atlas and guide. The Provincial Museum of Alberta, Edmonton, AB. 238 pp.

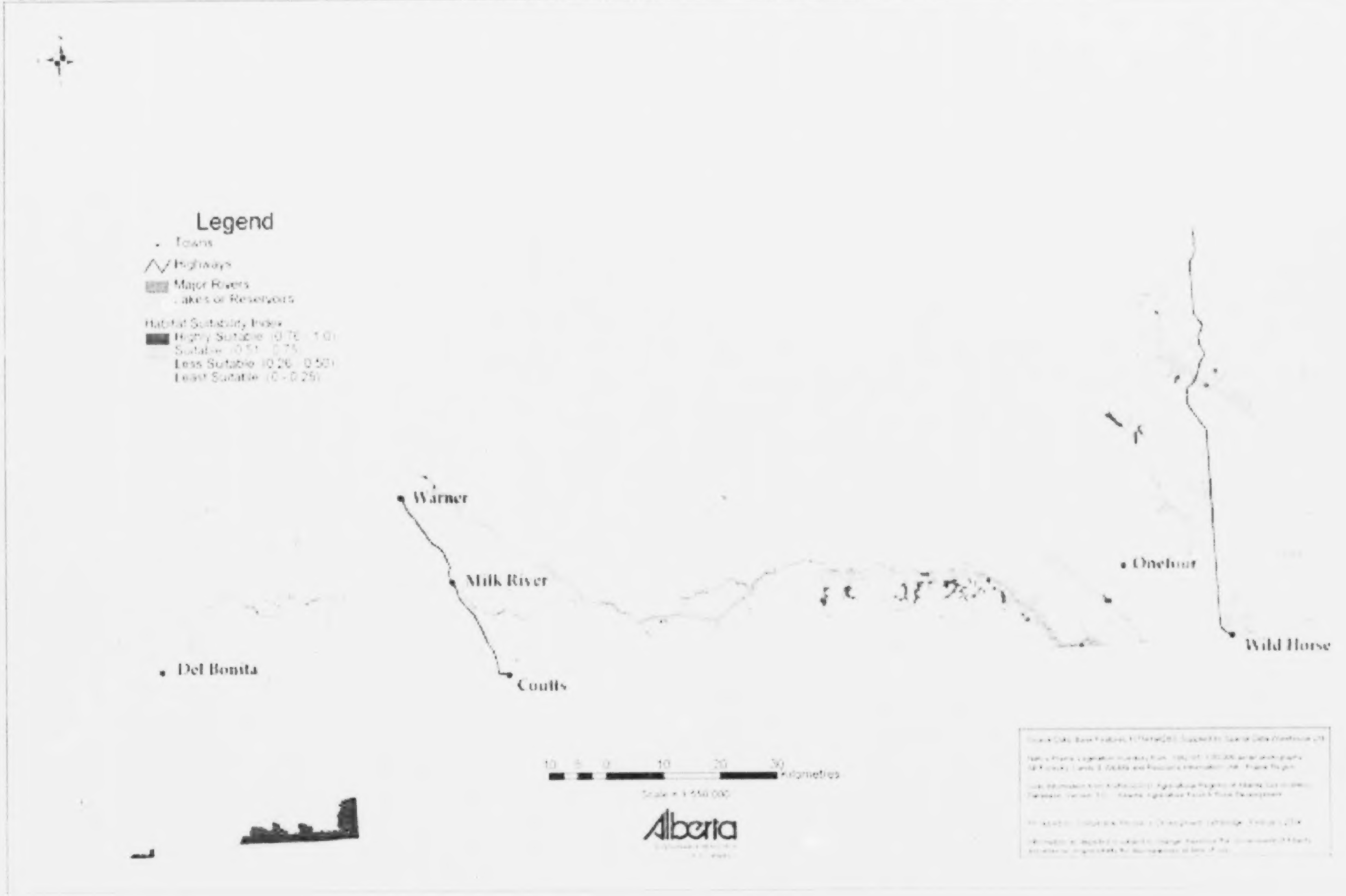
van Zyll de Jong, C. G. 1985. Handbook of Canadian mammals. 2. Bats. National Museum of Natural Science. Ottawa, ON. 212 pp.

10.0 PERSONAL COMMUNICATIONS

Barclay, R. M. R. Professor and Associate Head, Department of Biological Sciences, University of Calgary, Calgary, AB.

Lausen, C. PhD candidate. Department of Biological Sciences, University of Calgary, Calgary, AB.

Appendix L - Potential habitat for western small-footed myotis within the Milk River Basin


Legend
Towns
Highways
Major Rivers
Lakes or Reservoirs
Habitat Suitability Index
Highly Suitable (0.76 - 1.0)
Suitable (0.51 - 0.75)
Less Suitable (0.26 - 0.50)
Least Suitable (0 - 0.25)
Warner
Milk River
Coutts
Del Bonita
Onefour
Wild Horse
10 5 0 10 20 30 Kilometres
Scale 1:550,000
Alberta

Great Plains Toad (*Bufo cognatus)*

Brad N. Taylor
Alberta Conservation Association, Lethbridge, AB

1.0 PURPOSE AND LIMITATIONS

The purpose of this model is to indicate potential habitat for the great plains toad (*Bufo cognatus*) within the Milk River Basin. As this is a landscape level model with coarse variables, it may not be directly applicable to other areas or for site-specific analysis.

2.0 GENERAL INFORMATION

The current status of the great plains toad in Alberta is "May Be At Risk" (Alberta Sustainable Resource Development 2001). Wershler and Smith (1992, cited by James 1998) identified six general population areas in Alberta: Empress/Bindloss, South Saskatchewan River/Hilda, Medicine Hat, Lost River/Milk River, Lake Newell/Little Rolling Hills, and Hays/Purple Springs. James (1998) notes that additional populations have been recorded in and near Canadian Forces Base (CFB) Suffield.

Great plains toads are opportunistic spring breeders and only breed after large precipitation events (Bragg and Smith 1943, Krupa 1994 cited by James 1998). A. Didiuk noticed great plains toads called anywhere from three weeks to more than six weeks (James 1998). Eggs hatch in one to five days (Krupa 1994, cited by James 1998) and in the United States tadpoles take anywhere from 18 to 49 days to metamorphose (Bragg and Smith 1943, Bragg 1946, and Krupa 1994, cited by James 1998).

3.0 HABITAT ASSOCIATIONS

3.1 Cover

Great plains toads primarily occur throughout the grasslands of central North America (Krupa 1990 cited by James 1998). In Alberta, great plains toads are found in the dry mixed grass of the southeastern corner of the province (James 1998). Wershler and Smith (1992 cited by James 1998) identified typical breeding habitat for great plains toads in Alberta to be shallow ponds with relatively fresh, clear water in sandy soil. Ephemeral ponds with little to no aquatic vegetation, a water depth of approximately one metre, and good water clarity appear to be the primary breeding habitat for great plains toads (Cottonwood Consultants 1986, Taylor and Downey 2003). A chernozemic/ solonetzic soil order combination seems to typify the general soil conditions for the area where great plains toad are found in the Milk River Basin (Taylor and Downey 2003). Great plains toads also appear to be associated with the regosolic soil order in the Canadian Forces Base (CFB) Suffield area (Taylor and Downey 2003).

3.2 Food

Smith and Bragg (1949) identified that ground-dwelling, nocturnal insects are the most commonly consumed prey of adult great plains toads. Tadpoles feed on algae and decomposing insect remains or vegetation (Bragg 1940, cited by James 1998).

4.0 HABITAT AREA REQUIREMENTS

Incidental observations by A. Didiuk suggested that adult great plains toads may move more than 1 km from known breeding ponds (James 1998). During the 2002 field studies, several great plains toad young of the year were noted ascending a side slope of the Lost River valley within 500 m of a presumed breeding pond that was nearly dry in early August.

5.0 ASSOCIATED SPECIES

Great plains toads are associated with other species that inhabit the dry mixed grass ecoregion. These species include the western hog-nosed snake (*Heterodon nasicus),* prairie rattlesnake *(Crotalus viridis viridis*), wandering and plains garter snakes (*Thamnophis spp.*), short-horned lizard (*Phrynosoma hernandesi hernandesi),* ferruginous hawk (*Buteo regalis),* loggerhead shrike *(Lanius ludovicianus),* American badger (*Taxidea taxus),* and Richardson's ground squirrel *(Spermophilis richardsonii).*

6.0 THE HSI MODEL

6.1 Selected Habitat Variables

6.1.1 Soil Order (V_1 & V_2)

Most of the toads in CFB Suffield are associated with the regosolic soil order (Figure 14.1); however, this soil order is relatively sparse in the Milk River Basin. Great plains toads are primarily found in soil orders that are primarily chernozemic and secondarily solonetzic in the Milk River Basin; however, these sites are adjacent to regosolic soils. Chernozemic/solonetzic soil orders accommodate the toads breeding requirements by allowing ponds to last longer due to the poor drainage attributed to solonetzic type soils (Figure 14.2).

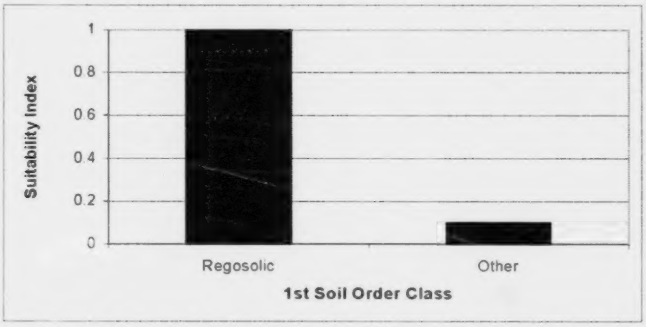


Figure 14.1 Great plains toad 1st soil order class habitat suitability histogram

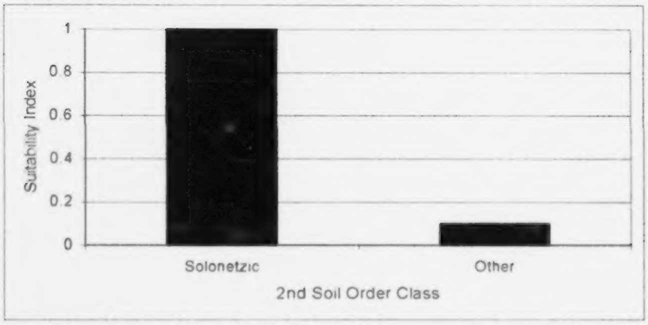


Figure 14.2 Great plains toad 2nd soil order class habitat suitability histogram

6.1.2 Soil Texture (V_3)

Soil texture is also important to the life history of the great plains toad. Sandy soils are indicated in the literature as one of the primary habitat characteristics. Moderately coarse and coarse soil textures (Table 14.1) are important for burrowing habitat. Texture data contained in the Agricultural Region of Alberta Soils Inventory Database (AGRASID) (Alberta Soil Information Centre 2001) was used to provide an indication of suitable burrowing sites. Consequently, moderately coarse (sandy loam) and coarse (sand and loamy sand) textured soils received high HSI values (Figure 14.3).

Table 14.1 Soil texture classifications

Soil Texture Classification	Symbol	Soil Textures Included
Coarse	C	Sands, Loamy sands
Moderately Coarse	MC	Sandy loam
Medium	M	Loam, Silt loam, Silt
Moderately Fine	MF	Sandy clay loam, Silty clay loam, Clay loam
Fine	F	Sandy clay, Silty clay, Clay

Footnote 1- U.S. Department of Agriculture Classification System adapted from Brady and Weil (1999)

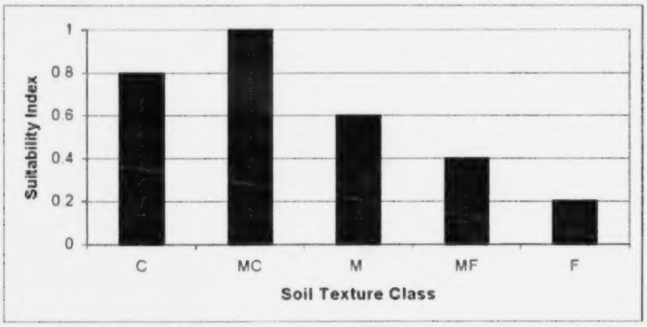


Figure 14.3 Great plains toad soil texture class habitat suitability histogram

6.1.3 Native Prairie Class (NPC) (V_4)

The Milk River population is relatively small and associated with high native prairie values (Figure 14.4). Native Prairie Class (NPC) is derived from the Native Prairie Vegetation Baseline Inventory developed by Alberta Environment. Class 1 is comprised of greater than 75% native prairie components (*i.e.* shrubs, graminoids, riparian areas, lakes, wetlands, and trees), Class 2 is 50 – 75%, Class 3 is 25 – 50%, Class 4 is 1 – 25%, and Class 5 is no native prairie components (Prairie Conservation Forum 2000).

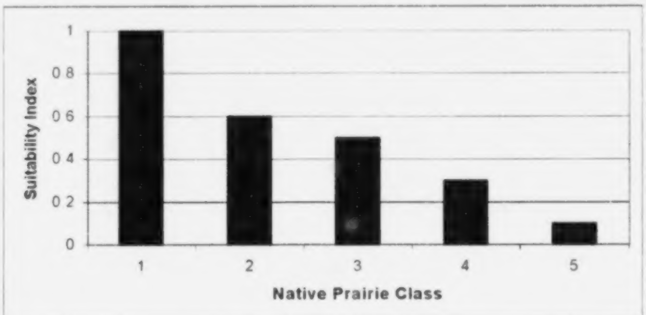


Figure 14.4 Great plains toad native prairie class habitat suitability histogram

7.0 HSI EQUATION

$$\mathbf{HSI = (0.5V_1 + V_2) * V_3 * V_4}$$

Because of the assumed soil order associations in the Milk River Basin, the variables are additive. Also, primary soil order is weighted as half the secondary soil order due to the importance of solonetzic soils as secondary soils. The sum of the soil order variables are equal and non compensatory with the remaining two variables of soil texture and native prairie class. These variables are relatively broad, but do provide a general indication of great plains toad habitat. Limitations with spatial data layers and specific habitat information prevent a detailed model from being developed at this time. Also, analysis of proximal and areal relationships between spatial data layers was not possible at the time of publication.

8.0 HABITAT SUITABILITY MAP

The habitat suitability map found in Appendix M identifies suitable habitat for the great plains toad in the Milk River Basin. Highly suitable areas for the great plains toads are limited to the south-eastern part of the basin which is consistent with their known distribution in the basin. A few areas outside their known distribution in the basin were identified as potentially suitable habitat. These areas may provide suitable habitat for the great plains toads and the species may have existed there in the past; however all current evidence on the species indicates that the toad is not found in these areas. These areas will be explored to test the validity of the model and to make further refinements if necessary.

9.0 LITERATURE CITED

Alberta Soil Information Centre. 2001. AGRASID30: Agricultural Region of Alberta Soil Inventory Database (Version 3.0). Edited by J. A. Brierley, T. C. Martin, and D. J. Spiess. Agriculture and Agri-Food Canada, Research Branch; Alberta Agriculture, Food and Rural Development, Conservation and Development Branch. Available: http://www1.agric.gov.ab.ca/soils/soils.nsf

Alberta Sustainable Resource Development. 2001. The General Status of Alberta Wild Species 2000. Alberta Sustainable Resource Development, Fish and Wildlife Service, Edmonton, AB. 46 pp. Publ. No. I/023.

Bragg, A. N. 1940. Observations on the ecology and natural history of Anura I. Habits, habitat, and breeding of *Bufo cognatus*. Say. Amer. Nat. 74(753): 322-349.

Bragg, A. N. 1946. Some Salientian adaptations. Great Basin Nat. 7(1): 11-15

Bragg, A. N. and C. C. Smith. 1943. Observations on the ecology and natural history of Anura IV. The ecological distribution of toads in Oklahoma. Ecology 24(3): 285-309.

Cottonwood Consultants. 1986. An overview of reptiles and amphibians in Alberta's grassland and parkland natural regions. Prepared for Wild West Program, World Wildlife Fund Canada, Toronto, ON. 63 pp. + appendices.

Graves, B. M., C. H. Summers, and K. L. Olmstead. 1993. Sensory mediation of aggregation of postmetamorphic *Bufo cognatus*. J. Herpetol. 27(3): 315-319.

James, J. D. 1998. Status of the Great Plains Toad (*Bufo cognatus*) in Alberta. Alberta Environmental Protection, Wildlife Management Division, and Alberta Conservation Association, Wildlife Status Report No. 14, Edmonton, AB. 26 pp.

Krupa, J. J. 1990. *Bufo cognatus* Say. Great Plains Toad. Catalogue of American Amphibians and Reptiles. 457.1 – 457.8.

Krupa, J. J. 1994. Breeding biology of the Great Plains Toad in Oklahoma. J. Herpetol. 28(2): 217 – 224.

Prairie Conservation Forum. 2000. Native Prairie Vegetation Baseline Inventory. [Online] http://albertapcf.terraengine.com/classinfo.htm Accessed Dec. 18, 2002.

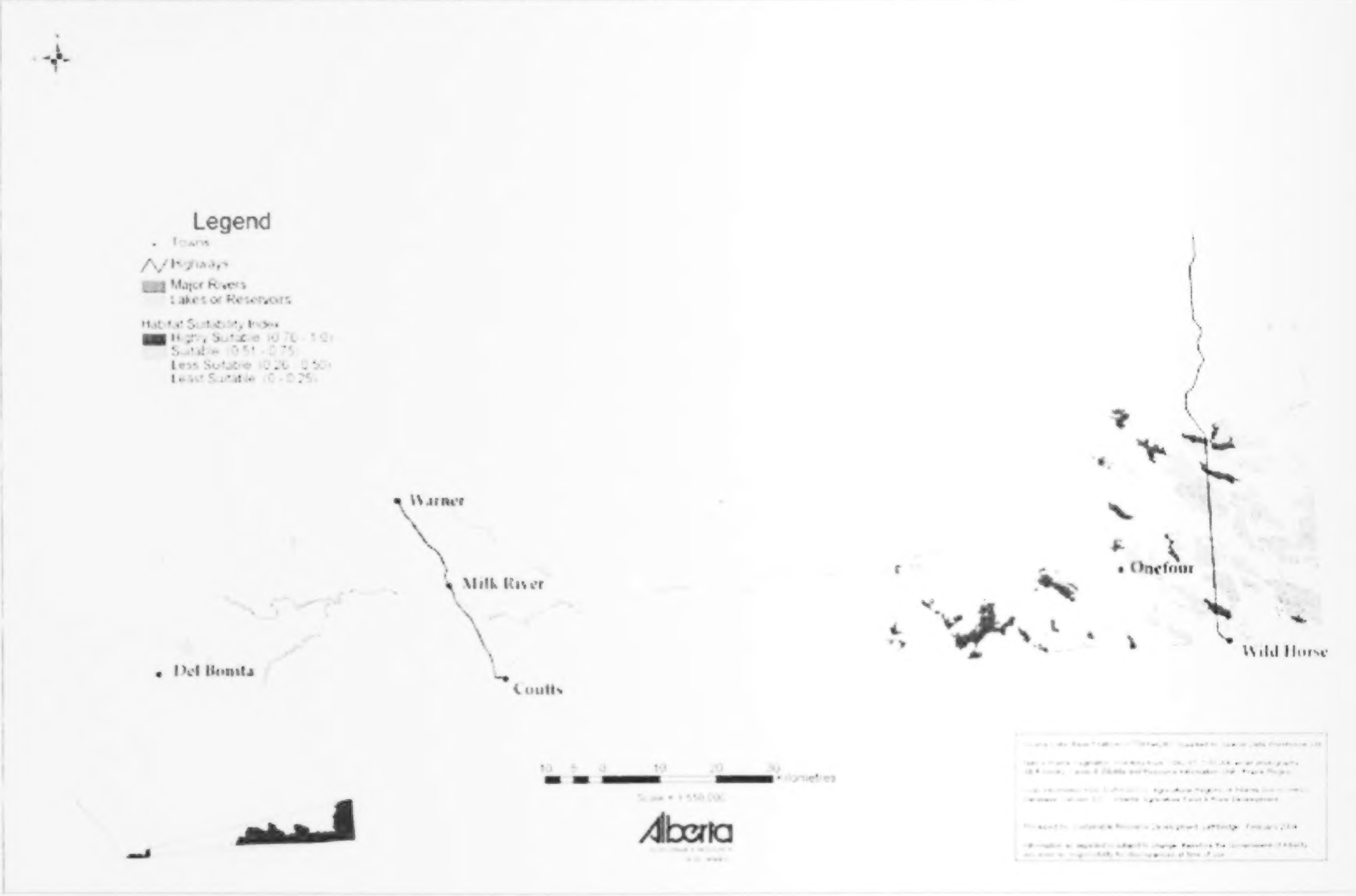
Smith, C. C. and A. N. Bragg. 1949. Observations on the ecology and natural history of Anura VII. Food and feeding habits of the common species of toad in Oklahoma. Ecology 30(3): 333-349.

Taylor, B. N. and B. A. Downey. 2003. Amphibian surveys of the Milk River Basin. Pages 93-103 in Quinlan, R. W., B. A. Downey, B. N. Taylor, P. F. Jones, and T. B. Clayton (eds.). A multi-species conservation strategy for species at risk in the Milk River basin: year 1 progress report. Alberta Sustainable Resource *Development, Fish and* Wildlife Division, Alberta Species at Risk Report No. 72, Edmonton, AB.

Wershler, C. and W. Smith. 1992. Status of the Great Plains Toad in Alberta – 1990. World Wildlife Fund Canada (Prairie for Tomorrow) / Alberta Forestry, Lands, and Wildlife. 23 pp.

Woodward, B. D. 1982. Predator-prey interactions and breeding-pond use of temporary-pond species in a desert anuran community. Ecology 64(6): 1549-1555.

Appendix M - Potential habitat for great plains toad within the Milk River Basin


Legend
• Towns
Highways
Major Rivers
Lakes or Reservoirs
Habitat Suitability Index
Highly Suitable (0.76 - 1.0)
Suitable (0.51 - 0.75)
Less Suitable (0.26 - 0.50)
Least Suitable (0 - 0.25)
Warner
Milk River
Coutts
Del Bonita
Onefour
Wild Horse
10 5 0 10 20 30 Kilometres
Alberta
Prepared by: Sustainable Resource Development, Lethbridge, February 2004

PLAINS SPADEFOOT (*Spea bombifrons*)

Brad N. Taylor
Alberta Conservation Association, Lethbridge, AB

1.0 PURPOSE AND LIMITATIONS

The purpose of this model is to indicate potential habitat for plains spadefoot (*Spea bombifrons*) within the Milk River Basin. As this is a landscape level model with coarse variables, it may not be directly applicable to other areas or for site-specific analysis.

2.0 GENERAL INFORMATION

The plains spadefoot is a plump anuran with short limbs and a pronounced spade-shaped tubercle on the inner surface of each hind foot (Seburn 1993). Spadefoots undergo explosive breeding in the spring following heavy precipitation events (Lauzon 1999). Lauzon noted single plains spadefoot could be heard calling from 1 km away and a large chorus could be heard from greater than 2 km away (Lauzon 1999). Females lay up to 2,000 eggs in masses of 10 to 250 eggs each (Bragg 1965 and Collins 1982, cited in Lauzon 1999). Spadefoot toads have the fastest larval development rate known among amphibians (Bragg 1965, cited in Lauzon 1999). In Alberta, metamorphosis usually requires 21 to 34 days after hatching with some spadefoot taking up to 60 days (Klassen 1998).

Spade-shaped tubercles on their hind feet help spadefoots to burrow. Under dry conditions they may burrow 60 to 90 cm below the surface (Bragg 1965, cited in Lauzon 1999). There are no published accounts of hibernation depths in Canada (Lauzon 1999).

The plains spadefoot is considered "May Be At Risk" in Alberta (Alberta Sustainable Resource Development 2001).

3.0 HABITAT ASSOCIATIONS

3.1 Cover

Spadefoots are confined to the more arid regions of North America (Lauzon 1999), and they are generally associated with ephemeral ponds and sandy soils (Cottonwood Consultants 1986, Lauzon 1999, Klassen 1998). Plains spadefoot have been strongly correlated with sandy soils in Alberta (Lauzon 1999) and have demonstrated significant overuse of moderately coarse textured soils (*i.e.* sandy loam) in the Milk River Basin (Taylor and Downey 2003). Ephemeral ponds less than 50 cm deep with little to no aquatic vegetation appear to be the main breeding habitat (Lauzon 1999, Taylor and Downey 2003). Other areas identified as plains spadefoot breeding habitat are sloughs with little vegetation, marshy depressions, flooded cultivated fields, temporary wetlands in pastures, river backwaters, and ditches (Klassen 1998).

3.2 Food

Spadefoots forage above ground and prey on various insects such as flies, hymenopterans, moths, beetles, pentatomids, and various spiders (Bragg 1944, cited in Lauzon 1999)

4.0 HABITAT AREA REQUIREMENTS

Habitat area requirements for plains spadefoot have been poorly studied (Lauzon 1999). Klassen (1998) noted juveniles over 2 km from known breeding ponds; however, they may have originated from unknown breeding locations.

5.0 ASSOCIATED SPECIES

Plains spadefoot may be a prey species for garter snakes (*Thamnophis spp.*), bullsnakes (*Pituophis catenifer sayi*) and western hog-nosed snakes (*Heterodon nasicus*). Tiger salamanders (*Abystoma tigrinum*), fairy shrimp (*Anostraca spp.*) and tadpole shrimp (*Notostraca spp.*) can be found in plains spadefoot breeding ponds. Species utilizing similar soil textures would be the Richardson's ground squirrel (*Spermophilis richardsonii*) and American badger (*Taxidea taxus*). The ferruginous hawk (*Buteo regalis*) is also associated with habitat used by the plains spadefoot.

6.0 THE HSI MODEL

6.1 Selected Habitat Variables

Since plains spadefoot are widely distributed across the Milk River Basin, the key variables for assessing habitat at the landscape level are soil texture and native prairie class (NPC).

6.1.1 Soil Texture (V_1)

Moderately coarse and coarse soil textures (Table 15.1) are important for burrowing habitat. Texture data contained in the Agricultural Region of Alberta Soils Inventory Database (AGRASID) (Alberta Soil Information Centre 2001) was used to provide an indication of suitable burrowing sites (Figure 15.1).

Table 15.1 Soil texture classifications

Soil Texture Classification	Symbol	Soil Textures Included
Coarse	C	Sands, Loamy sands
Moderately Coarse	MC	Sandy loam
Medium	M	Loam, Silt loam, Silt
Moderately Fine	MF	Sandy clay loam, Silty clay loam, Clay loam
Fine	F	Sandy clay, Silty clay, Clay

Footnote 1- U.S. Department of Agriculture Classification System adapted from Brady and Weil (1999)

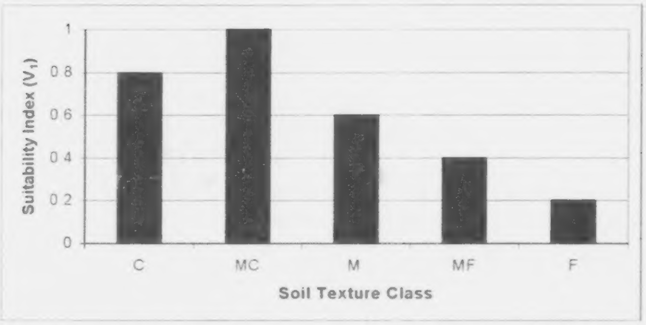


Figure 15.1 Plains spadefoot soil texture classification habitat suitability histogram

6.1.2 Native Prairie Class (V_2)

Native Prairie Class (NPC) is derived from the Native Prairie Vegetation Baseline Inventory developed by Alberta Environment. Class 1 is comprised of greater than 75% native prairie components (i.e. shrubs, graminoids, riparian areas, lakes, wetlands, and trees). Class 2 is 50 – 75%, Class 3 is 25 – 50%, Class 4 is 1 – 25%, and Class 5 is no native prairie components (Prairie Conservation Forum 2000). Plains spadefoot appear to select for Class 1 native prairie and select against Class 5 native prairie in the Milk River Basin (Taylor and Downey 2003) (Figure 15.2).

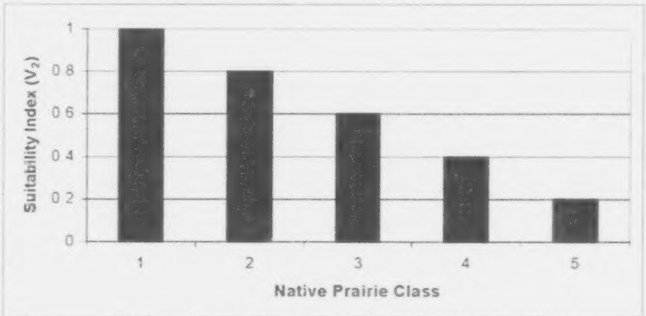


Figure 15.2 Plains spadefoot native prairie habitat suitability histogram

7.0 HSI EQUATION

$$HSI = V_1 * V_2$$

Both variables are considered equal and non-compensatory (low values of one variable cannot be compensated by the other) in defining the quality of habitat for plains spadefoot in the Milk River Basin. These are relatively broad variables and only provide a general indication of potential plains spadefoot habitat.

8.0 HABITAT SUITABILITY MAP

Please refer to Appendix N for the colour map depicting potentially suitable habitat for the plains spadefoot in the Milk River Basin. Potentially suitable habitat is found continuously throughout the basin. Oddly there are no detections of this species south of Cypress hills and the Milk River Ridge even though highly suitable habitat exists in these areas. Further exploration will be required to confirm the presence of the plains spadefoot in these areas.

9.0 LITERATURE CITED

Alberta Soil Information Centre. 2001. AGRASID30: Agricultural Region of Alberta Soil Inventory Database (Version 3.0). Edited by J. A. Brierley, T. C. Martin, and D. J. Spiess. Agriculture and Agri-Food Canada, Research Branch; Alberta Agriculture, Food and Rural Development, Conservation and Development Branch. Available: http://www1.agric.gov.ab.ca/soils/soils.nsf

Alberta Sustainable Resource Development. 2001. The General Status of Alberta Wild Species 2000. Alberta Sustainable Resource Development, Fish and Wildlife Service, Edmonton, AB. 46 pp. Publ. No. I/023.

Brady, N. C. and R. R. Weil. 1999. The Nature and Properties of Soils- Twelfth edition. Prentice Hall Inc. Upper Saddle River, New Jersey, U.S.A. 881 pp.

Bragg, A. N. 1944. The spadefoot toads in Oklahoma with a summary of our knowledge of the group. Amer. Nat. 78: 517-533.

Bragg, A. N. 1965. Gnomes of the night: the spadefoot toads. University of Pennsylvania Press, Philadelphia, PA. 127 pp.

Collins, J. T. 1982. Amphibians and reptiles in Kansas. Second edition. Univ. Kansas Mus. Nat. Hist., Kansas Pub. Edu. Ser. 8, Lawrence, KS. 356 pp.

Cottonwood Consultants. 1986. An overview of reptiles and amphibians in Alberta's grassland and parkland natural regions. Prepared for Wild West Program, World Wildlife Fund Canada, Toronto, ON. 63 pp. + appendices.

Klassen, M. A. 1998. Observations of the breeding and development of the Plains Spadefoot, Scaphiopus bombifrons, in southern Alberta. Can. Field-Nat. 112: 387-392.

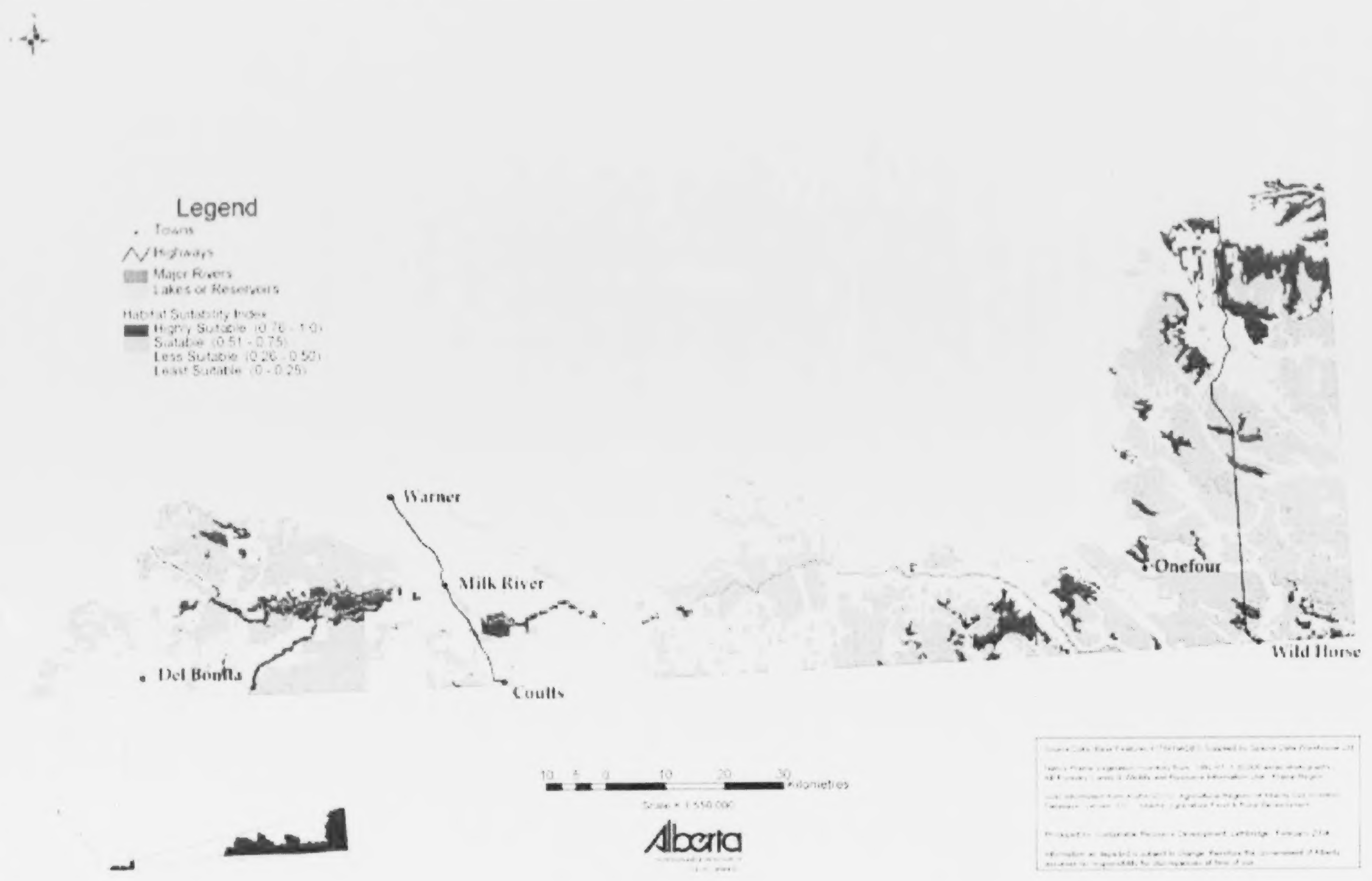
Lauzon, R. 1999. Status of the Plains Spadefoot (Spea bombifrons) in Alberta. Alberta Environment, Fisheries and Wildlife Management Division, and Alberta Conservation Association, Wildlife Status Report No. 25, Edmonton, AB. 17 pp.

Prairie Conservation Forum. 2000. Native Prairie Vegetation Baseline Inventory. [Online] http://albertapcf.terraengine.com/classinfo.htm Accessed Dec. 18, 2002.

Seburn, D. 1993. Handbook for monitoring the amphibians of Alberta. Prepared for the Department of Environmental Protection, Fish and Wildlife Services, Edmonton, AB. 64 pp.

Taylor, B. N. and B. A. Downey. 2003. Amphibian surveys of the Milk River Basin. Pages 93-103 in Quinlan, R. W., B. A. Downey, B. N. Taylor, P. F. Jones, and T. B. Clayton (eds.). A multi-species conservation strategy for species at risk in the Milk River basin: year 1 progress report. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Report No. 72, Edmonton, AB.

Appendix N - Potential habitat for plains spadefoot within the Milk River Basin


Legend
Towns
Highways
Major Rivers
Lakes or Reservoirs
Habitat Suitability Index
Highly Suitable (0.76 - 1.0)
Suitable (0.51 - 0.75)
Less Suitable (0.26 - 0.50)
Least Suitable (0 - 0.25)
Warner
Milk River
Del Bonita
Coutts
Onefour
Wild Horse
10 5 0 10 20 30 Kilometres
Scale = 1:550,000
Alberta

Prairie Rattlesnake *(Crotalus viridis viridis)*

Kelley J. Kissner
Alberta Fish and Wildlife, Medicine Hat, AB

1.0 PURPOSE AND LIMITATIONS

The purpose of this model is to indicate potential habitat for the prairie rattlesnake (*Crotalus viridis viridis)* within the Milk River Basin. As this is a landscape level model with coarse variables, it may not be directly applicable to other areas or for site-specific analysis.

2.0 GENERAL INFORMATION

In Canada, the prairie rattlesnake (*Crotalus viridis viridis*) reaches the northern limit of its distribution in southern Alberta and Saskatchewan. In the southern portion of its range, this species occurs throughout the central United States to northern Mexico. In Alberta, prairie rattlesnakes are designated as "May Be At Risk" due to apparent declines in their population size (Watson and Russell 1997, Alberta Sustainable Resource Development 2001)

Prairie rattlesnakes are heavy-bodied snakes that vary in size from 370 –1400 mm in total length (Russell and Bauer 2000). The background colour ranges from tan to medium brown with darker blotches along the dorsal and lateral sides. The head is triangular and two heat-sensing pits occur on the upper jaw, one between and below each eye and nostril. The most distinguishing feature of rattlesnakes is the rattle at the base of the tail.

3.0 HABITAT ASSOCIATIONS

3.1 Hibernation

During the winter months (mid-October to mid-April) rattlesnakes hibernate in dens (hibernacula) that protect them from freezing temperatures. Suitable sites for hibernacula include stable slump blocks, meander scarps and fissures, sinkholes, rocky outcrops, and mammal burrows (Cottonwood Consultants 1986,1987, Didiuk 1999). In Alberta, these features tend to be associated with major river valleys, and most hibernation sites are located along the breaks and coulees of the South Saskatchewan, Red Deer, Bow, Oldman and Milk Rivers. Didiuk (1999) reported that 8 of 11 den sites found within Canadian Forces Base Suffield were burrows dug by coyotes or badgers, and suggested that burrowing mammals provide access to underground cracks and crevices suitable for hibernation. Hibernacula tend to be located on south, east, or southeast facing slopes because these aspects provide maximum solar insolation and protection from prevailing winds (Didiuk 1999).

Many rattlesnakes and other snake species (see associated species) often den together in a single den site, and snakes show high yearly fidelity to individual sites (Cottonwood Consultants 1986, 1987, Hofman 1991, Kissner et al. 1996, Didiuk 1999). These observations suggest that favourable overwintering habitat may be limited. Because a large number of snakes often den together, the destruction of a single site may have a severe impact on snake populations.

Rattlesnake hibernacula are afforded year-round protection through the Wildlife Act, making it illegal to destroy hibernacula.

3.2 Food

Prairie rattlesnakes prey upon small mammals, ground nesting birds, amphibians, and reptiles which they hunt or ambush (Russell and Bauer 2000). The two heat-sensing pits on their upper jaw aid rattlesnakes in finding warm-blooded prey. Upon emergence from hibernation, snakes move to upland habitat in search of prey. Observations of radio-marked individuals in southern Alberta suggest that rattlesnakes move to areas of high small mammal abundance and forage in these areas until the onset of hibernation (Didiuk 1999). Occasionally, rattlesnakes are observed in cultivated areas or pasture land if these areas intersect native habitat or if small mammal abundance is high (A. Didiuk, R. Ernst, E. Hofman, pers. comm.).

3.3 Reproduction

Rattlesnakes mate at or near hibernation sites in the fall. Females store sperm over the winter, ovulate and fertilize ova the following spring, and give birth to young in the fall (Russell and Bauer 2000). Upon emergence, gravid female rattlesnakes aggregate at "rookery" sites that are typically close to hibernacula. The biophysical characteristics of these sites are not well understood, however, the presence of large, flat table rocks overlying abandoned mammal burrows appear to be common features (Duvall et al. 1985). Shrubs (e.g. sagebrush (*Artemesia cana*)) are also commonly observed at rookery sites (J. Nicholson, pers. comm.). It is assumed that these features provide favourable conditions for thermoregulation during gestation and provide access to cover from predators (Watson and Russell 1997). Didiuk (1999) did not find evidence that gravid female rattlesnakes within the boundaries of Canadian Forces Base Suffield aggregated at typical rookery sites. However, females migrated to burrows along the escarpment of the South Saskatchewan River short distances away from their hibernacula (typically 0.2-1 km), which presumably also provided appropriate basking conditions and cover from predators.

3.4 Thermal Relief and Cover

Because rattlesnakes are ectotherms, their body temperature typically fluctuates with the thermal environment. Snakes can regulate their body temperature using behavioural thermoregulation which typically involves shuttling between sun and shade. Rattlesnakes commonly use burrows, bases of sagebrush, or dense grass for shade during the day, or at night when ambient temperature is low (Didiuk 1999). In Alberta, rattlesnakes may also seek cover in treed areas, particularly young or old cottonwood stands (A. Didiuk, E. Hofman, R. Ernst, pers. comm.).

Roads may provide basking opportunities for snakes because of their exposure to solar radiation. Unfortunately, the behaviour of snakes to use roads to bask or simply just to cross often results in mortality. The light tan colouration of rattlesnakes makes them appear somewhat cryptic, particularly on gravel roads, possibly increasing their susceptibility to road mortality.

4.0 HABITAT AREA REQUIREMENTS

Movement data from radio-marked snakes suggest that rattlesnakes typically make long distance dispersals away from hibernacula. Didiuk (1999) found that five radio-marked snakes within Canadian Forces Base Suffield travelled to foraging sites 12-25 km from their hibernacula. Long distance movements from hibernacula have also been recorded for *Crotalus viridis* in Wyoming (Duvall et al. 1985)

5.0 SPECIES ASSOCIATIONS

A variety of other species of snakes den with rattlesnakes, including bullsnakes (*Pituophis catenifer*), wandering garter snakes (*Thamnophis elegans*), Plains garter snakes (*T. radix*), and occassionally western hog-nosed snakes (*Heterodon nasicus*). During the summer months, bullsnakes and rattlesnakes are often observed in the same types of habitats, possibly because they rely to a large degree on small mammal prey. Burrows dug by coyotes (*Canis latrans*) and badgers (*Taxidea taxus*) are typically used as hibernacula by rattlesnakes.

6.0 The HSI Model

6.1 Selected Habitat Variables

The habitat associations of prairie rattlesnakes appear to differ depending on whether snakes are hibernating, foraging, or reproducing. Consequently, the HSI model for prairie rattlesnakes must incorporate the habitat requirements for all of these activities.

6.2 Identifying Potential Wintering Habitat

6.2.1 Distance from Escarpment of Major River, Drainage, or Coulee (V_1)

Most rattlesnake hibernacula occur within 4 km of a major river, drainage, or coulee (K.Kissner, pers. obs.) (Figure 16.1).

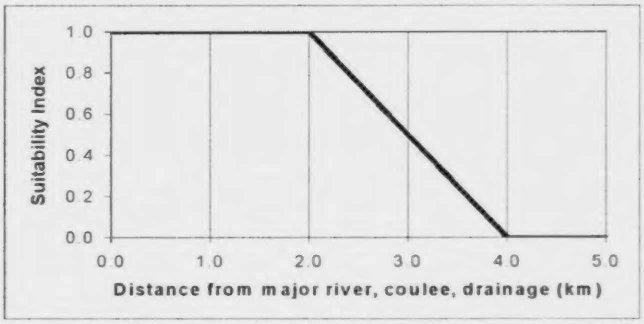


Figure 16.1 Distance from major river, coulee, or drainage for winter habitat suitability index for the prairie rattlesnake

6.2.2 Slope (V_2)

Low to moderate slopes appear to be common features of rattlesnake hibernacula. Slopes that are very steep tend not be used (Figure 16.2).

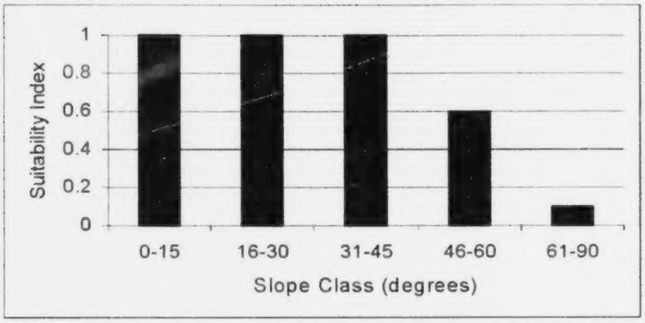


Figure 16.2 Slope class habitat suitability index for the prairie rattlesnake

6.2.3 Presence/Absence of Slumping of Slopes (V_3)

The presence of slumping appears to be a common feature associated with rattlesnake hibernacula (Figure 16.3).

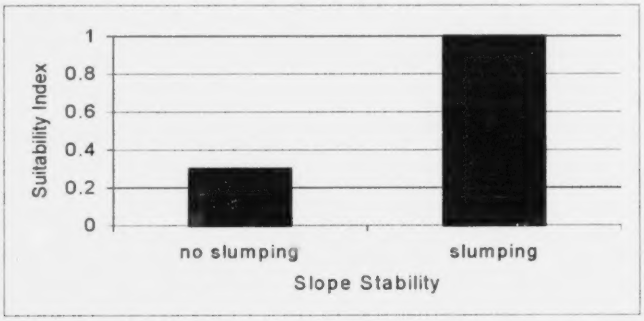


Figure 16.3 Slope stability habitat suitability index for the prairie rattlesnake

6.2.4 Aspect (V_4)

Hibernacula are typically located on south, east, and southeast facing slopes (Figure 16.4).

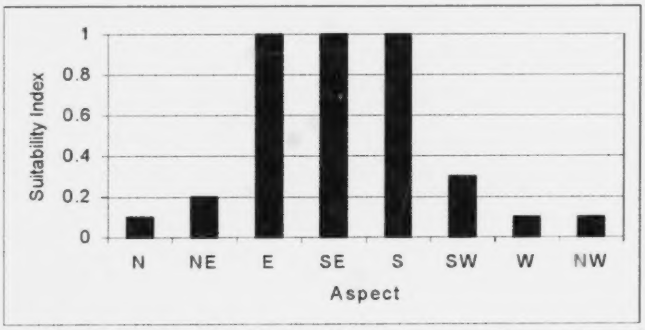


Figure 16.4 Aspect for winter habitat suitability index for the prairie rattlesnake

6.3 HSI Equation for Wintering Habitat

GIS coverages for slope (V_2) and slumping (V_3) were not available to model potential habitat for prairie rattlesnakes. Alternatively, a landscape model variable available from the Agricultural

Region of Alberta Soil Inventory Database (AGRASID) was chosen that described areas of rough terrain in which hibernacula might occur. This variable Ih4 in AGRASID describes a landscape that is characterized by high relief, moderate to steep slopes, and greater than 10% exposed bedrock (Figure 16.5).

6.3.1 Landscape Model (V_5)

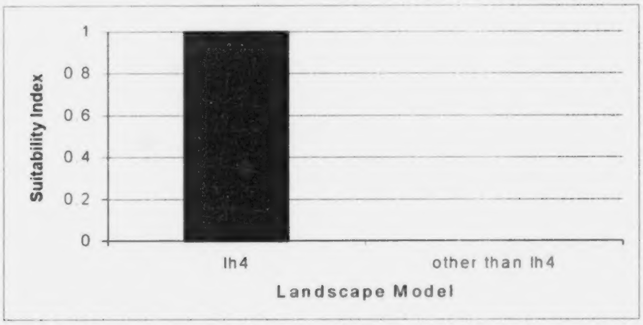


Figure 16.5 Landscape model habitat suitability index for the prairie rattlesnake

$$\textbf{HSI Winter} = V_1 * V_4 * V_5$$

Hibernacula of prairie rattlesnakes occur within approximately 4 km of a major river, coulee, or drainage (V_1). Within this area, they are typically on south, east or southeast slopes (V_4) and are in areas of rough terrain (V_5).

6.4 Identifying Potential Summer Habitat (Habitat used for Foraging and Thermal Relief)

6.4.1 Distance from Major River, Drainage, or Coulee (V_6)

The available data on home range sizes of rattlesnakes in Alberta suggests that snakes migrate as far as 25 km from their hibernacula (Didiuk 1999). Den sites are typically located along major river valleys, drainages, or coulees. Consequently, the likelihood of snakes using habitat beyond 25 km from these features is less likely (Figure 16.6).

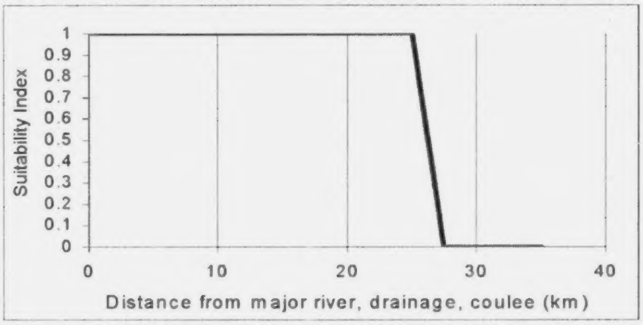


Figure 16.6 Distance from major river, drainage or coulee for summer habitat suitability index for the prairie rattlesnake

6.4.2 Road Density (V_7)

Roads may provide somewhat suitable basking habitat for snakes; however, the high incidence of mortality of snakes on roads makes this feature unsuitable for snakes (Figure 16.7).

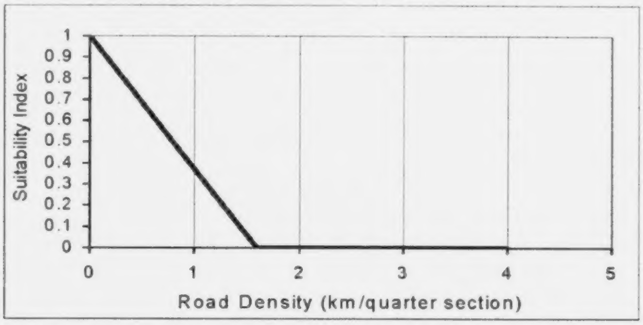


Figure 16.7 Road density habitat suitability index for the prairie rattlesnake

6.4.3 Road Type (V_8)

Road type should affect the number of snakes killed on roads due to differences in traffic intensity on these roads (Figure 16.8).

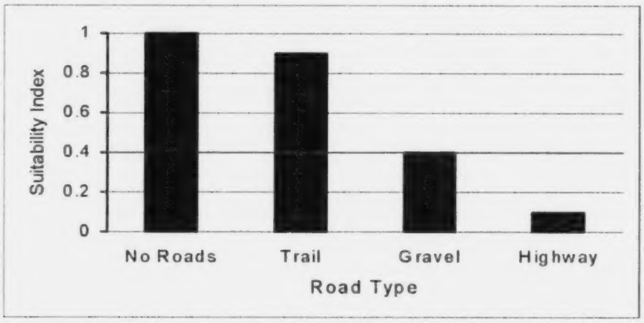


Figure 16.8 Road type habitat suitability index for the prairie rattlesnake

6.4.4 Native Prairie Class (V_9)

Rattlesnakes primarily use native habitat because these areas typically have higher densities of prey species, such as rodents and grassland birds. Rattlesnakes may use cultivated fields while moving across the landscape, or if small mammal abundance is high in these areas. Native Prairie Class 1 = >75% native prairie components (npc), 2 = 50-75% npc, 3 = 25-50% npc, 4 = 1-25% npc, 5 = 0% npc (Figure 16.9).

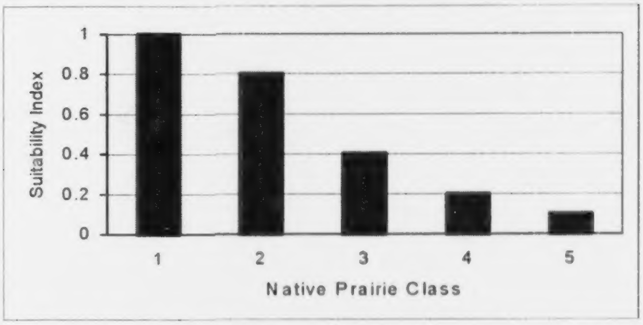


Figure 16.9 Native prairie class habitat suitability index for the prairie rattlesnake

6.4.5 Human density (V_{10})

Areas of high human density are unsuitable for snakes (Figure 16.10).

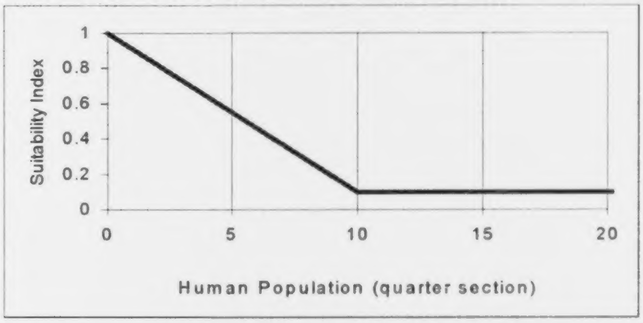


Figure 16.10 Human population habitat suitability index for the prairie rattlesnake

6.4.6 Shrub/Tree Cover (V_{11})

Shrubs and trees can provide good foraging habitat, habitat for thermal relief, and cover from predators. Therefore, some cover is preferable to none (Figure 16.11).

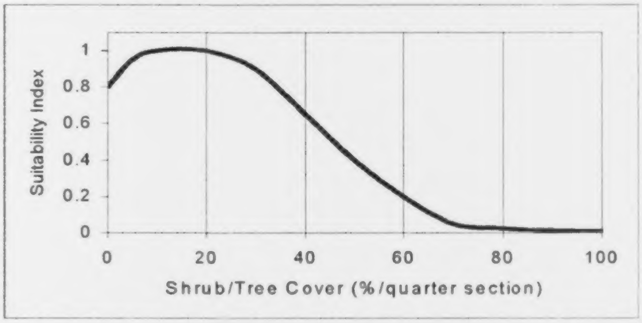


Figure 16.11 Shrub/tree cover habitat suitability index for the prairie rattlesnake

6.5 HSI Equation for Summer Habitat

A GIS coverage for human density was not available so this variable was excluded from the model.

$$HSI = V_6 * (V_7 * V_8 + V_9 + V_{11})/3$$

Within an area of 25 km of a major river, coulee, or drainage, areas that have low densities of roads, particularly low densities of highways and secondary highways, areas of native prairie habitat, or areas with low to moderate densities of shrubs may be used by prairie rattlesnakes. Roads may provide basking opportunities for snakes, but snakes are often killed on roads. Native prairie habitat is typically characterized by higher densities of the prey types rattlesnakes prefer. Areas with low to moderate shrubs may will provide thermal relief for snakes while foraging or at night when ambient temperature declines.

6.6 Identifying Potential Rookery Habitat for Gravid Female Prairie Rattlesnakes

6.6.1 Distance from Major River, Drainage, or Coulee (V_{12})

Few rookery sites have been located in southern Alberta. Of the few that have been located, most have been located within 1 km of the rim of a major river valley, coulee, or drainage (A.Didiuk, unpubl. data) and are generally located near hibernation sites (Figure 16.12).

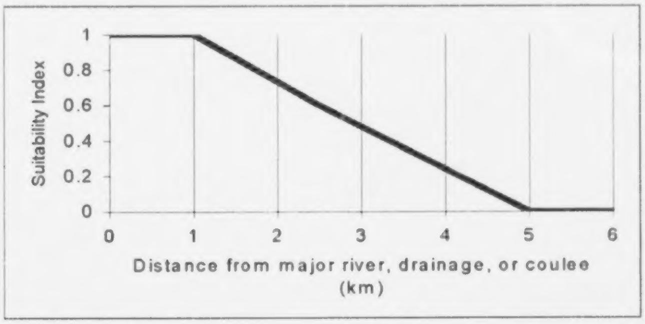


Figure 16.12 Distance from major river, drainage or coulee for rookery habitat suitability index for the prairie rattlesnake

6.6.2 Aspect (V_{13})

South, east, or southeast aspects provide maximum solar insulation and protection from prevailing winds (Figure 16.13).

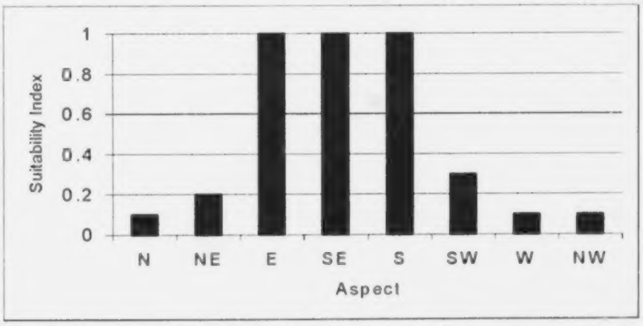


Figure 16.13 Aspect for rookery habitat suitability index for the prairie rattlesnake

6.6.3 Shrub cover (V_{14})

A shrub component is typical of rookery sites and may be used for thermal relief and cover (J. Nicholson, pers. comm.) (Figure 16.14).

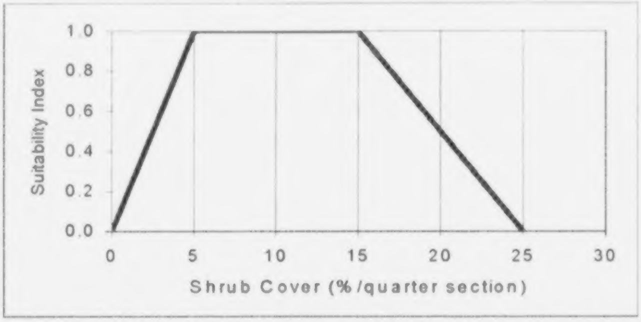


Figure 16.14 Shrub cover for rookery habitat suitability index for the prairie rattlesnake

6.6.4 Bare rock cover (V_{15}):

Females often choose rookery sites with large table rocks, which provide good basking microhabitat and cover from predators (Figure 16.15).

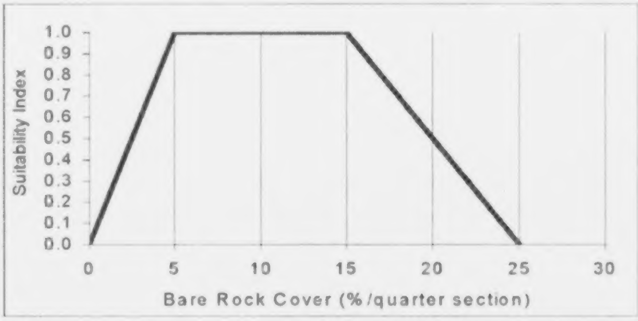


Figure 16.15 Bare rock cover habitat suitability index for the prairie rattlesnake

6.7 HSI Equation for Rookery Habitat

$$\mathbf{HSI} = V_{12} * V_{13} * (\mathrm{Max} V_{14 \text{ or }} V_{15})$$

Within areas that are within 1-5 km from major river, coulee and drainage and that have south, east, or southeast aspect, females may chose sites with moderate shrub cover or bare rock cover as rookery sites.

7.0 Overall HSI Equation

Rookery habitat may not be able to be modelled at the quarter section level because small scale characteristics (shrub cover and rock cover) are likely important than the landscape level characteristics. Because rookeries are typically close to den sites, it is likely that habitat delineated for hibernation should encompass rookery sites. Consequently, it is not included in the final HSI model.

7.0.1 Elevation (V_{16})

A final variable that will limit habitat for hibernation, foraging/thermal relief, and for reproduction is elevation. Generally, prairie rattlesnakes do not occur above 1200 m (Figure 16.16).

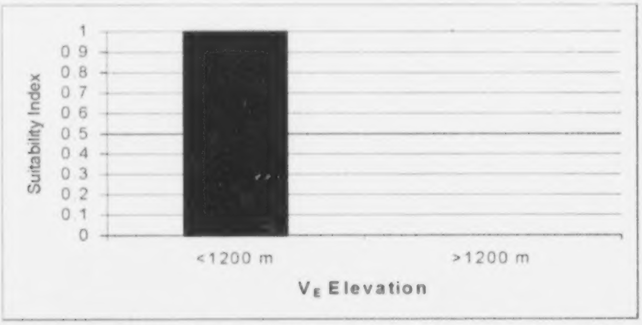


Figure 16.16 Elevation habitat suitability index for the prairie rattlesnake

$$HSI = Max\ (HSIwinter, HSIsummer) * V_{16}$$

In areas that have an elevation less than 1200m, habitat for prairie rattlesnakes will be delimitated by the maximum value for habitat used for hibernation or for foraging and thermal relief.

8.0 HABITAT SUITABILITY MAP

The habitat suitability map found in Appendix O illustrates suitable habitat for the prairie rattlesnake in the Milk River Basin. The most suitable areas are found in the east-central areas of the basin, which is consistent with the known distribution of the prairie rattlesnake. However several areas to the west were also selected as potentially suitable habitat. Historical accounts by landowners in this area recount the occurrence of rattlesnakes. Exploration of these areas within the western part of the basin is needed to determine the western extent of the rattlesnake in the Milk River Basin.

9.0 LITERATURE CITED

Alberta Agriculture, Food and Rural Development 2001. Agricultural Region of Alberta Soil Inventory Database. AGRASID version 3.0. Available online at http://www.agric.gov.ab.ca/soil/agrasid/metadata.html

Cottonwood Consultants Ltd. 1986. An overview of reptiles and amphibians in Alberta's grassland and parkland natural regions. Cottonwood Consultants Ltd. and World Wildlife Fund Canada, Calgary.

Cottonwood Consultants Ltd. 1987. Alberta snake hibernacula survey, 1987. Cottonwood Consultants Ltd. and World Wildlife Fund Canada, Calgary.

Didiuk, A.B. 1999. Reptile and Amphibian Component Report. Canadian Forces Base Suffield, National Wildlife Area, Wildlife Inventory. Unpubl. report by Canadian Wildlife Service, Edmonton, Alberta. 70pp.

General Status of Wild Species. 2000. Sustainable Resource Development. Fish and Wildlife Service. 46 pp.

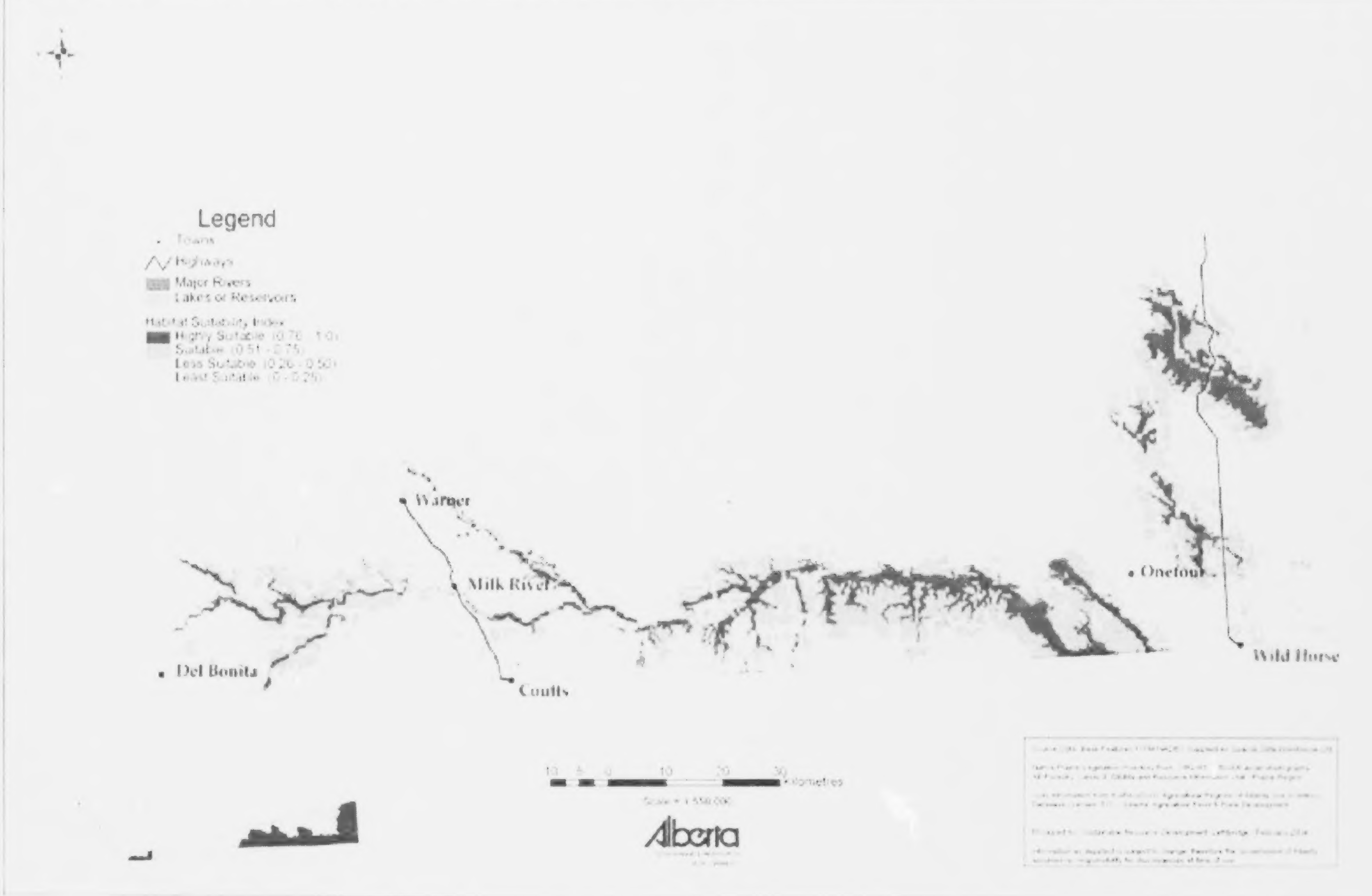
Hofman, D.E. 1991. 1990 Central region snake hibernaculae survey. Unpubl. report, Alberta Fish and Wildlife Division, Central Region, Red Deer.

Kissner, K.J., D.M. Secoy, M.R. Forbes. 1996. Assessing population size and den use of Prairie Rattlesnakes (*Crotalus viridis viridis*) in southern Saskatchewan. Grassland National Park annual report, vol.1: 27-34.

Russell, A.P. and A.M. Bauer. 2000. The Amphibians and Reptiles of Alberta. A Field Guide and Primer of Boreal Herpetology. University of Calgary Press, Calgary. 279 pp.

Watson, S.M and A.P. Russell. 1997. Status of the Prairie Rattlesnake (*Crotalus viridis viridis*) in Alberta. Alberta Environmental Protection, Wildlife Management Division, Wildlife Status Report No. 6. Edmonton, AB. 26 pp.

Appendix O - Potential habitat for prairie rattlesnake within the Milk River Basin


Legend
Towns
Highways
Major Rivers
Lakes or Reservoirs
Habitat Suitability Index
Highly Suitable (0.76 - 1.0)
Suitable (0.51 - 0.75)
Less Suitable (0.26 - 0.50)
Least Suitable (0 - 0.25)
Warner
Milk River
Del Bonita
Coutts
Onefour
Wild Horse
10 5 0 10 20 30 Kilometres
Alberta

Short-horned Lizard *(Phrynosoma hernandesi hernandesi)*

Brad N. Taylor
Alberta Conservation Association, Lethbridge, AB

1.0 PURPOSE AND LIMITATIONS

The purpose of this model is to indicate potential habitat for short-horned lizards (*Phrynosoma hernandesi hernandesi)* within the Milk River Basin. As this is a landscape level model with coarse variables, it may not be directly applicable to other areas or for site-specific analysis.

2.0 GENERAL INFORMATION

The short-horned lizard is Alberta's only lizard. It is indigenous to semi-arid, short grass portions of the northern Great Plains and usually found in rather rough terrain (Conant and Collins 1991). The short-horned lizard is small, well camouflaged, and is a "sit and wait" predator (James *et al.* 1997). Population densities in Alberta appear to be low (Powell 1982, Powell and Russell 1993a). Short-horned lizards are currently classified as "May Be At Risk" in Alberta (Alberta Sustainable Resource Development 2001).

3.0 GENERAL HABITAT ASSOCIATIONS

3.1 Cover

In Alberta, short-horned lizards are mainly found on sparsely vegetated, south facing slopes of coulees and canyons along the interface between the prairie grassland and valley bottom (Powell 1982, Powell and Russell 1991, 1993a, James 2002). Short-horned lizards are also associated with exposed Bearpaw shale (McCorquedale 1965, cited by James *et al.* 1997). Powell and Russell (1991, 1993a) identified three basic habitat types for short-horned lizards. The Milk River Basin habitat type is characterized by the ecotone between the short grass prairie and the coulee and canyon margins. The Bearpaw habitat type is comprised of sandy dunes formed from Bearpaw shale and is commonly matted with creeping juniper (*Juniperus horizontalis*). North Marginal habitat occurs at the most northerly extensions of short-horned lizard range and tends to be restricted to north rims of canyons and coulees with southern exposures.

3.2 Food

Most short-horned lizards feed on ants (Pianka and Parker 1975), however, short-horned lizards in Alberta exhibit a more generalist feeding pattern (Powell 1982). Ants, beetles, and grasshoppers made up 36, 24, and 22 percent dry weight in their diet, respectively (Powell 1982).

4.0 HABITAT AREA REQUIREMENTS

Short-horned lizards are prone to relatively long movements (> 30m) from mid-summer to early fall and have a median home range of 601m^2 (Powell and Russell 1993b, 1996).

5.0 ASSOCIATED SPECIES

The habitat of prairie rattlesnakes (*Crotalus viridis viridis*), western hog-nosed snakes (*Heterodon nasicus*), garter snakes (*Thamnophis spp.*), and great plains toads (*Bufo cognatus*) all overlap short-horned lizard habitat. Ferruginous hawks (*Buteo regalis*), Northern harriers (*Circus cyaneus*), Loggerhead shrike (*Lanius ludovicianus*), and Northern grasshopper mouse (*Onychomys leucogaster*) can also be found in areas suitable for short-horned lizards.

6.0 The HSI MODEL

6.1 Selected Habitat Variables

6.1.1 Topographical Features (V_1)

Historic short-horned lizard observations were analyzed at the landscape level utilizing Arcview 3.2 and the Agricultural Region of Alberta Soils Inventory Database (AGRASID) Morphology data layer (Alberta Soil Information Centre 2001). The utilization-availability methodology suggested by Neu *et al.* (1974) was used to determine overuse or underuse of the topographical features. Analysis of Short-horned lizard sightings from BSOD found that they selected for habitat associated with valleys while all other features were selected against ($\chi^2 = 612.0$, $\rho < 0.0001$; Taylor Unpublished). Short-horned lizard radio telemetry data indicated forays up to 70m from the valley break into the adjoining prairie (Powell and Russell 1996). Most of the daily movement patterns during the summer rarely exceeded 30m, and generally occurred along the slopes of the valleys or valley bottoms (Powell and Russell 1996). Consequently, all valleys and all prairie habitat within 100m of valleys would be considered the best potential habitat (Figure 17.1).

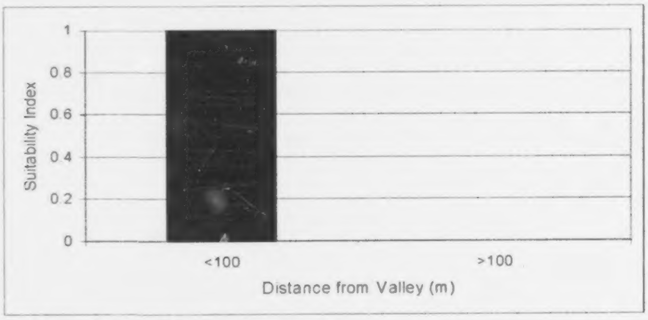


Figure 17.1 Topographical habitat suitability index for the short-horned lizard

6.1.2 Native Prairie Class (V_2)

Native Prairie Class (NPC) is derived from the Native Prairie Vegetation Baseline Inventory developed by Alberta Environment. Class 1 is comprised of greater than 75% native prairie components (*i.e.* shrubs, graminoids, riparian areas, lakes, wetlands, and trees), Class 2 is 50 – 75%, Class 3 is 25 – 50%, Class 4 is 1 – 25%, and Class 5 is 0%

native prairie components (Prairie Conservation Forum 2000). Short-horned lizards are generally not found in areas that exhibit high levels of cultivation; consequently, as NPC increases the HSI value decreases (Figure 17.2).

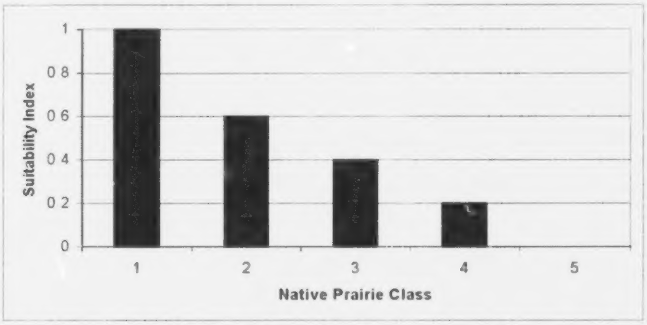


Figure 17.2 Habitat suitability index for native prairie for the short-horned lizard

6.1.3 Elevation (V_3)

Analysis of Short-horned lizard sites from BSOD found that they generally occur at elevations below 1100 m within the Milk River Basin of Alberta, however, a few short-horned lizards have been observed above this point (Taylor Unpublished). No lizards have been recorded above 1200 m (Figure 17.3).

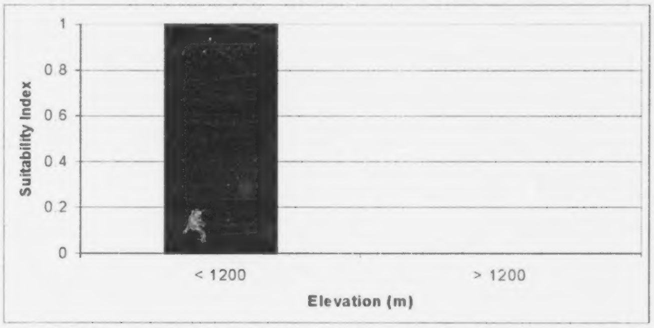


Figure 17.3 Habitat suitability index for elevation for the short-horned lizard

6.1.4 Riparian Zones (V_4)

Short-horned lizards generally are not found in riparian zones because thick vegetation inhibits their movement and their thermoregulatory abilities. Due to the coarse resolution of the Native Prairie Vegetation Baseline Inventory polygons, quarter sections that contained more than 5% riparian features would be downgraded but not excluded from potential habitat sites (Figure 17.4).

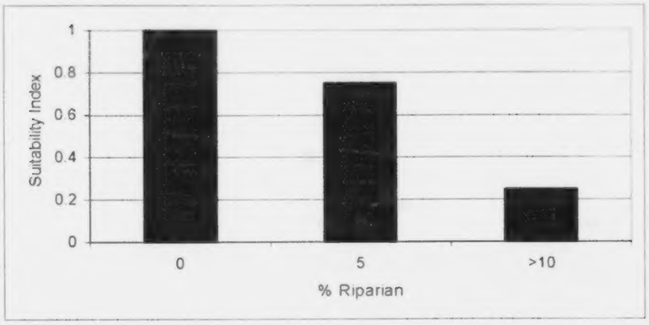


Figure 17.4 Habitat suitability index for percent riparian features for the short-horned lizard

7.0 HSI EQUATION

$$HSI = V_1 * V_2 * V_3 * V_4$$

All variables in this equation are considered equal and non-compensatory (low values of one variable can not be compensated by higher values of another) in defining the quality of habitat for short-horned lizards in the Milk River Basin. The equation is based on the assumption that the short-horned lizard is restricted to valley breaks and bottoms below 1100 m. It is further assumed that cultivated and riparian areas are poor habitat. Analysis of proximal and area relationships between spatial data layers was not possible at the time of publication.

7.1 Other Variables Considered

7.1.1 Slope

Moderately shallow to moderately steep slopes (10 – 60 degrees) appear to be the selected habitat for short-horned lizards; however, this is generally at the microhabitat level. Very general slope categories were created for the landscape model; however, due to the scale and refinement of the data layer this variable was excluded from final calculations.

7.1.2 Aspect

The majority of short-horned lizards are found on south facing slopes, although along the Milk River, lizards have been noted on other aspects. Due to the scale and refinement of the data layer this variable was also excluded from final calculations.

8.0 HABITAT SUITABILITY MAP

Please refer to Appendix P for a colour map indicating potential habitat for short-horned lizards within the Milk River Basin. Potential habitat for the short-horned lizard in the Milk River Basin clearly identifies some of the known areas of lizard occupancy. The map also indicates some areas that may need some additional exploration in order to test the validity of the model and to make further refinements.

9.0 LITERATURE CITED

Alberta Soil Information Centre. 2001. AGRASID30: Agricultural Region of Alberta Soil Inventory Database (Version 3.0). Edited by J.A. Brierley, T.C. Martin, and D.J. Spiess. Agriculture and Agri-Food Canada, Research Branch; Alberta Agriculture, Food and Rural Development, Conservation and Development Branch. Available: http://www1.agric.gov.ab.ca/soils/soils.nsf

Alberta Sustainable Resource Development. 2001. The General Status of Alberta Wild Species 2000. Alberta Sustainable Resource Development, Fish and Wildlife Service, Edmonton, AB. 46 pp. Publ. No. I/023.

Conant, R. and J.T. Collins. 1991. Reptiles and Amphibians: Eastern/Central North America. 3rd Edition. Boston: Houghton Mifflin Co. 450 pp.

James, J.D. 2002. A survey of short-horned lizards (*Phrynosoma hernandesi hernandesi*) populations in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Report No. 29, Edmonton, AB. 25 pp.

James, J.D., A.P. Russell, and G.L. Powell. 1997. Status of the Eastern Short-horned Lizard (*Phrynosoma douglassii brevirostre*) in Alberta. Alberta Environmental Protection, Wildlife Management Division, Wildlife Status Report No. 5, Edmonton, AB. 20 pp.

McCorquedale, B. 1965. Some peculiar aspects of the biota of the Cypress Hills. Pp. 55-65 IN: R.L. Zell, editor. Alberta Society of Petroleum Geologists 13th Annual Field Conference Guide, Part 1.

Neu, C.W., C.R. Byers, and J.M. Peek. 1974. A technique for analysis of utilization-availability data. J. Wildl. Manage. 38(3): 541-545.

Pianka, E.R., and W.S. Parker. 1975. Ecology of horned lizards: a review with special reference to *Phrynosoma platyrhinos*. Copeia 1975: 141-162.

Powell, G.L. 1982. The Eastern Short-horned Lizard in Alberta: Basic field ecology of northern marginal populations. M.Sc. thesis, University of Calgary, Calgary, AB. 343 pp.

Powell, G. L., and A.P. Russell. 1991. Distribution of the Eastern short-horned lizards (*Phrynosoma douglassii brevirostre)* in Alberta. Northwest. Natur. 72: 21-26.

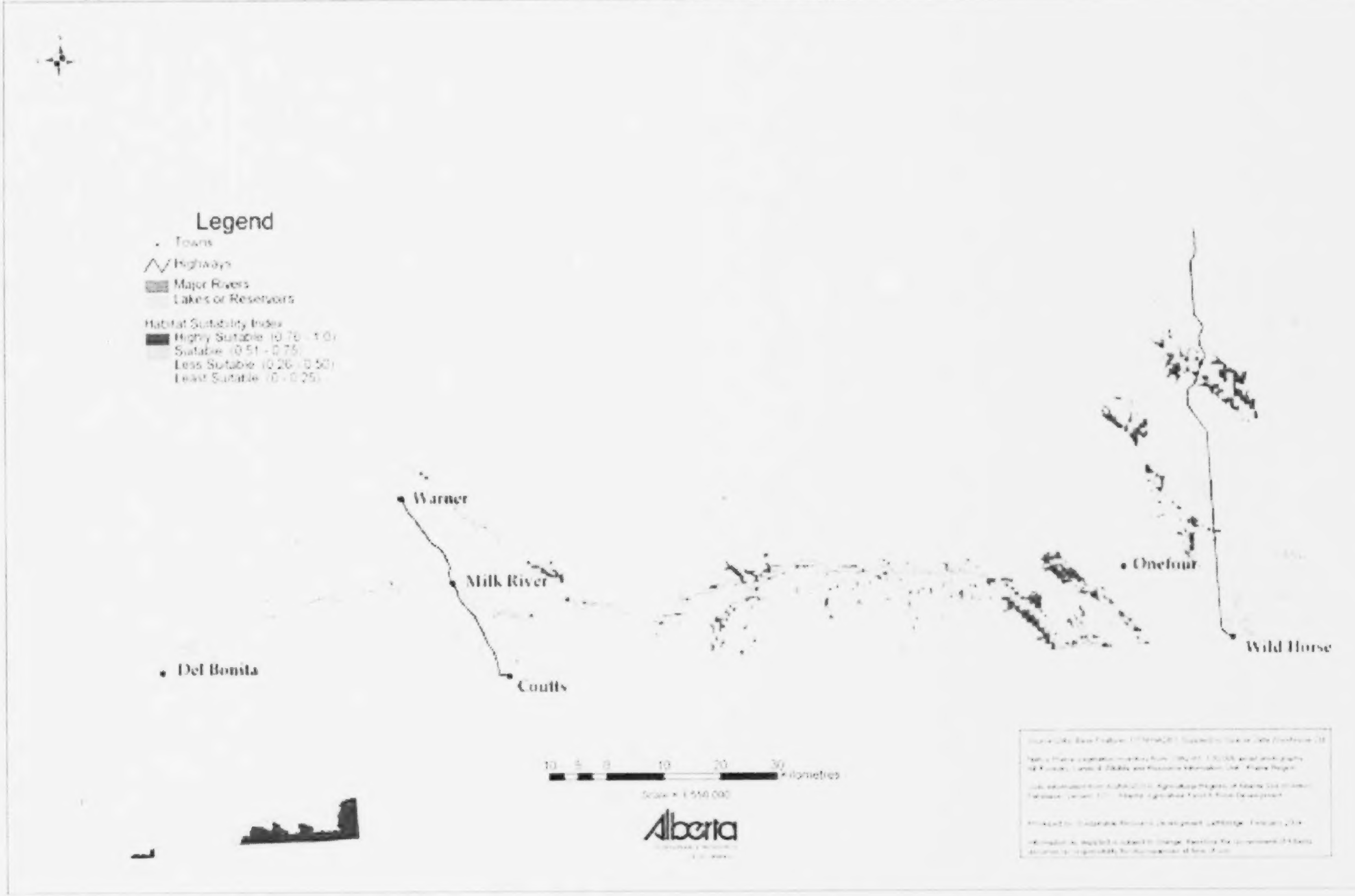
Powell, G.L., and A.P. Russell. 1993a. The range and status of the Eastern Short-horned Lizard in the Canadian prairies. Pp. 278-290 IN: G.L. Holroyd, H.L. Dickson, M. Regnier, and H.C. Smith, eds. Proceedings of the 3rd prairie conservation and endangered species workshop. Prov. Mus. Alberta Nat. Hist. Paper No. 19, Edmonton, AB. 384 pp.

Powell, G.L., and A.P. Russell. 1993b. A radio telemetric study of movement and thermal ecology in an Alberta population of the Eastern Short-horned Lizard (*Phrynosoma douglassii brevirostre*). Unpubl. report to Alberta Fish and Wildlife Division, Lethbridge, AB. 74 pp.

Powell, G.L., and A.P. Russell. 1996. Movement, thermal ecology, seasonal activity, and overwintering behaviour in an Alberta population of the Eastern Short-horned Lizard (*Phrynosoma douglassii brevirostre*). Alberta Fish and Wildlife Division, Lethbridge, AB. 128 pp.

Prairie Conservation Forum. 2000. Native Prairie Vegetation Baseline Inventory. [Online] http://albertapcf.terraengine.com/classinfo.htm Accessed Dec. 18, 2002.

Appendix P - Potential habitat for short-horned lizard within the Milk River Basin


Legend
Towns
Highways
Major Rivers
Lakes or Reservoirs
Habitat Suitability Index
Highly Suitable (0.76 - 1.0)
Suitable (0.51 - 0.75)
Less Suitable (0.26 - 0.50)
Least Suitable (0 - 0.25)
Warner
Milk River
Coutts
Del Bonita
Onefour
Wild Horse
10 5 0 10 20 30 Kilometres
Scale = 1:550,000
Alberta

Weidemeyer's Admiral *(Limenitis weidemeyerii)*

Brad N. Taylor
Alberta Conservation Association, Lethbridge, AB

PURPOSE AND LIMITATIONS

The purpose of this model is to indicate potential habitat for Weidemeyer's admirals (*Limenitis weidemeyerii)* within the Milk River Basin. As this is a landscape level model with coarse variables, it may not be directly applicable to other areas or for site-specific analysis.

2.0 GENERAL INFORMATION

The Weidemeyer's admiral is a relatively large butterfly that is mostly black with bold white bands on both wing surfaces and extensive grayish white markings on the underside of the hind wings (Canadian Wildlife Service 2002, N. Kondla, pers. comm.). It is widely distributed in the western interior of the United States; however, it is limited to an 80 km stretch along the Milk River and its tributaries in southeastern Alberta (Canadian Wildlife Service 2002, N. Kondla, pers. comm.). The Weidemeyer's admiral is currently considered "May be at Risk" (Alberta Sustainable Resource Development 2001).

3.0 GENERAL HABITAT ASSOCIATIONS

Admirals use the woody riparian vegetation along the valleys associated with the Milk River and its tributaries, particularly the shrub complexes (Canadian Wildlife Service 2002, N. Kondla, pers. comm.). Weidemeyer's admirals are typically associated with deciduous treed and shrubby areas, which provide the necessary habitat components: larval host plants, moisture and nectar sources for adults, and elevated perches for mate location (Canadian Wildlife Service 2002, N. Kondla, pers. comm.). Within the Milk River drainage, Pike (1987) identified the following tree and shrub species that were common to areas where adult Weidemeyer's admiral were observed: cottonwoods (*Populus deltoides* and hybrids), saskatoon (*Amelanchier alnifolia*), western clematis (*Clematis ligusticifolia*), and thorny buffaloberry (*Shepherdia argentea*). If one or more of these species were missing, adults were not observed. Willow (*Salix spp.*) occurring in large stands or thickets is a negative indicator for Weidemeyer's admirals (Pike 1987).

4.0 HABITAT AREA REQUIREMENTS

Studies on the area requirements of Weidemeyer's admiral have not been conducted.

5.0 ASSOCIATED SPECIES

Given its strict habitat limitations, the Weidemeyer's admiral is not closely associated with other species, although there are a few species that may share similar habitat types. The loggerhead shrike (*Lanius ludovicianus*) is also associated with shrub complexes, particularly thorny buffaloberry. Western small-footed bats (*Myotis ciliolabrum ciliolabrum)* are associated with riparian cottonwoods, prairie falcons (*Falco mexicanus*) are often found nesting along cliffs in the Milk River valley, and short-horned lizards (*Phrynosoma hernandesi hernandesi*) are also found in the ecotone between plains and valleys in the Milk River.

6.0 THE HSI MODEL

6.1 Selected Habitat Variables

Two variables were selected to model potential habitat for Weidemeyer's Admiral. Topographical features (V_1) derived from the Agricultural Region of Alberta Soils Inventory Database (AGRASID; Alberta Soil Information Centre 2001) and percent shrub cover (V_2) derived from the Native Prairie Vegetation Baseline Inventory developed by Alberta Environment (Prairie Conservation Forum 2000).

6.1.1 Topography (V_1)

Valleys are the only areas identified as being capable of sustaining sufficient habitat for the Weidemeyer's admiral; consequently, all other areas (*i.e.* plains, uplands, benches, escarpments, plateaus) received an HSI value of 0 (Figure 18.1).

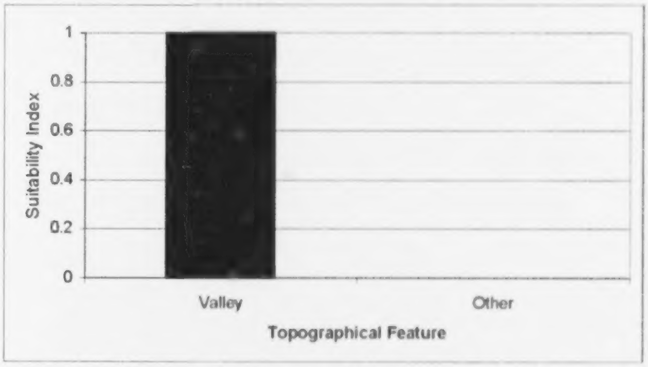


Figure 18.1 Habitat suitability index for topographical features for the Weidemeyer's admiral

6.1.2 Shrub Cover (V_2)

Areas devoid of shrubs would not meet the habitat requirements of this species. However, zero percent shrub cover was still given a value since it is possible that shrubs in a riparian zone were simply classed as riparian in the Native Prairie database, or shrubs were present but did not constitute five percent of the quarter section (Figure 18.2).

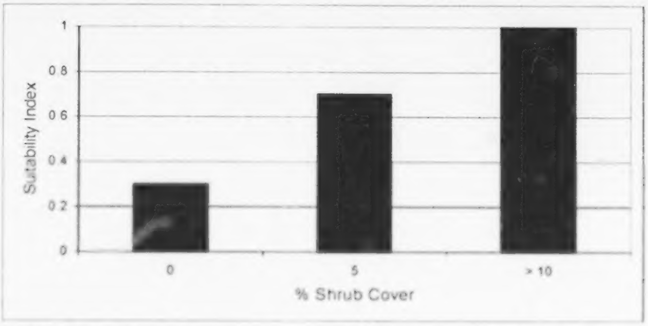


Figure 18.2 Habitat suitability index for percent shrub cover for the Weidemeyer's admiral

7.0 HSI EQUATION

$$HSI = V_1 * V_2$$

Weidemeyer's admirals are limited to the valleys, as well as to areas where shrubs are present. Consequently, the formula is designed to reduce the habitat suitability in areas where there are not any valleys or there is a low percentage of shrub cover.

8.0 HABITAT SUITABILITY MAP

Please refer to Appendix Q for a colour map indicating potential habitat for Weidemeyer's admiral butterflies within the Milk River Basin. According to this model, the best potential habitat for Weidemeyer's admiral in the Milk River Basin is associated with the valley shrub complexes along the tributaries to the Milk River. This corresponds to known occurrences of the species. Although some of the potential habitat identified is outside of the known range of these butterflies, these areas should be investigated to confirm presence or absence in order to refine the model.

9.0 LITERATURE CITED

Alberta Soil Information Centre. 2001. AGRASID30: Agricultural Region of Alberta Soil Inventory Database (Version 3.0). Edited by J.A. Brierley, T.C. Martin, and D.J. Spiess. Agriculture and Agri-Food Canada, Research Branch; Alberta Agriculture, Food and Rural Development, Conservation and Development Branch. Available: http://www1.agric.gov.ab.ca/soils/soils.nsf

Alberta Sustainable Resource Development. 2001. The General Status of Alberta Wild Species 2000. Alberta Sustainable Resource Development, Fish and Wildlife Service, Edmonton, AB. 46 pp. Publ. No. I/023.

Canadian Wildlife Service. 2002. Species at Risk – Weidemeyer's Admiral. [Online] http://www.speciesatrisk.gc.ca/species/search/SearchDetail_e.cfm?SpeciesID=635. Accessed January 7, 2003.

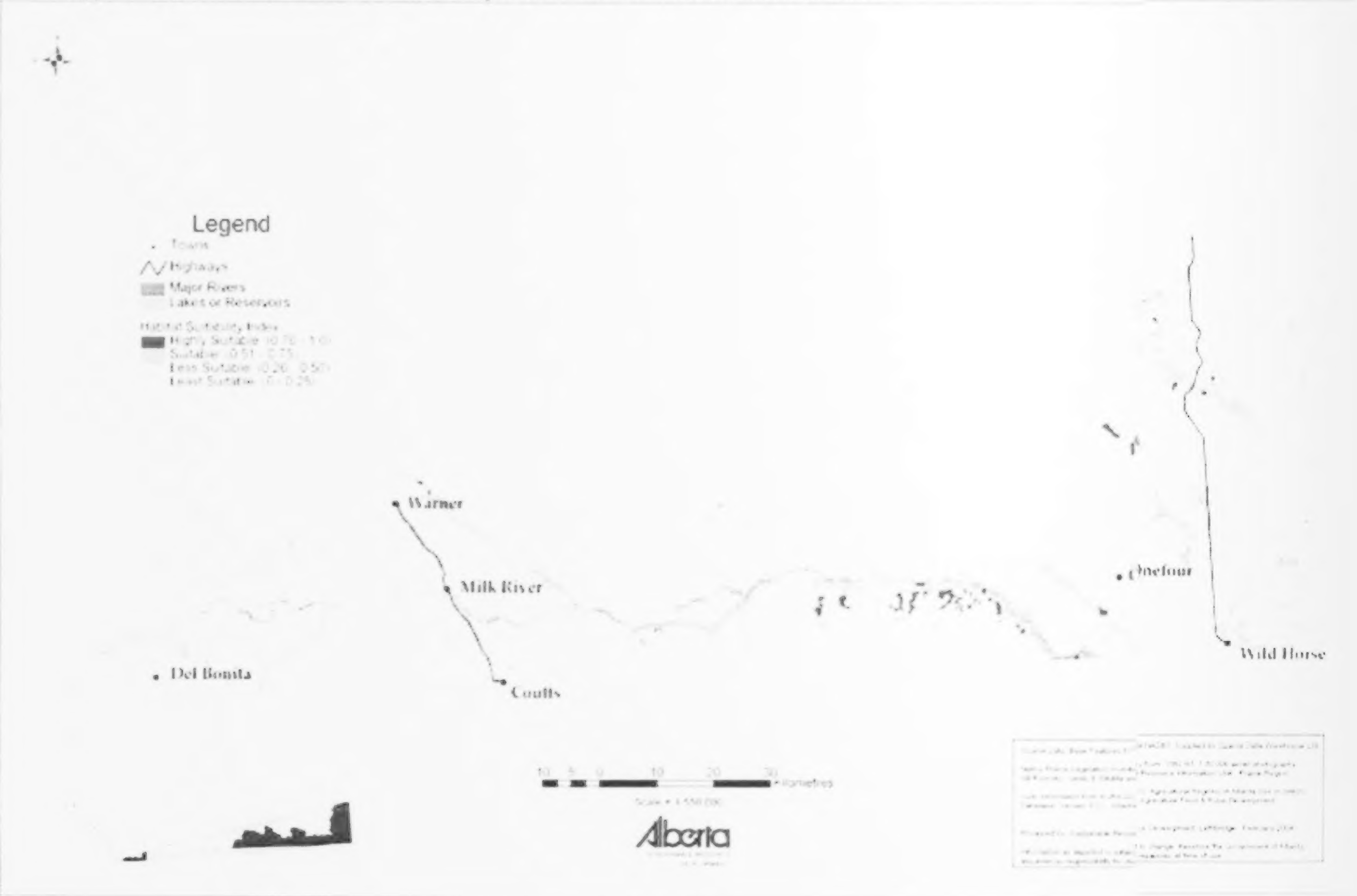
Pike, E.M. 1987. *Limenitis Weidemeyerii* or Weidemeyer's Admiral in Canada. Unpublished report for World Wildlife Fund Canada. 10 pp.

Prairie Conservation Forum. 2000. Native Prairie Vegetation Baseline Inventory. [Online] http://albertapcf.terraengine.com/classinfo.htm Accessed Dec. 18, 2002.

10.0 PERSONAL COMMUNICATIONS

Kondla, Norbert G. BC Fish and Wildlife, Castlegar, BC.

Appendix Q - Potential habitat for Weidemeyer's admiral within the Milk River Basin


Legend
Towns
Highways
Major Rivers
Lakes or Reservoirs
Habitat Suitability Index
Highly Suitable (0.76 - 1.0)
Suitable (0.51 - 0.75)
Less Suitable (0.26 - 0.50)
Least Suitable (0 - 0.25)
Warner
Milk River
Coutts
Del Bonita
Onefour
Wild Horse
10 5 0 10 20 30
Kilometres
Alberta